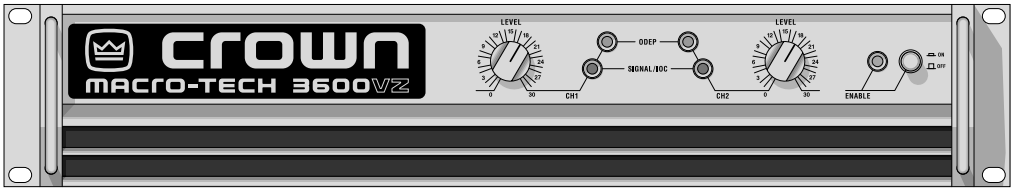
# MACRO-TECH®

# REFERENCE MANUAL




## Model:
## Macro-Tech 3600VZ

Some models may be exported under the name *Amcron*.®

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# THREE YEAR FULL WARRANTY

## WORLDWIDE

**SUMMARY OF WARRANTY**

The Crown Audio Division of Crown International, Inc., 1718 West Mishawaka Road, Elkhart, Indiana 46517-4095 U.S.A. warrants to you, the ORIGINAL PURCHASER and ANY SUBSEQUENT OWNER of each NEW Crown[1] product, for a period of three (3) years from the date of purchase by the original purchaser (the "warranty period") that the new Crown product is free of defects in materials and workmanship, and we further warrant the new Crown product regardless of the reason for failure, except as excluded in this Crown Warranty.

[1] *Note: If your unit bears the name "Amcron," please substitute it for the name "Crown" in this warranty.*

**ITEMS EXCLUDED FROM THIS CROWN WARRANTY**

This Crown Warranty is in effect only for failure of a new Crown product which occurred within the Warranty Period. It does not cover any product which has been damaged because of any intentional misuse, accident, negligence, or loss which is covered under any of your insurance contracts. This Crown Warranty also does not extend to the new Crown product if the serial number has been defaced, altered, or removed.

**WHAT THE WARRANTOR WILL DO**

We will remedy any defect, regardless of the reason for failure (except as excluded), by repair, replacement, or refund. We may not elect refund unless you agree, or unless we are unable to provide replacement, and repair is not practical or cannot be timely made. If a refund is elected, then you must make the defective or malfunctioning product available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers. We will remedy the defect and ship the product from the service center within a reasonable time after receipt of the defective product at our authorized service center.

**HOW TO OBTAIN WARRANTY SERVICE**

You must notify us of your need for warranty service not later than ninety (90) days after expiration of the warranty period. All components must be shipped in a factory pack. Corrective action will be taken within a reasonable time of the date of receipt of the defective product by our authorized service center. If the repairs made by our authorized service center are not satisfactory, notify our authorized service center immediately.

**DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES**

YOU ARE NOT ENTITLED TO RECOVER FROM US ANY INCIDENTAL DAMAGES RESULTING FROM ANY DEFECT IN THE NEW CROWN PRODUCT. THIS INCLUDES ANY DAMAGE TO ANOTHER PRODUCT OR PRODUCTS RESULTING FROM SUCH A DEFECT.

**WARRANTY ALTERATIONS**

No person has the authority to enlarge, amend, or modify this Crown Warranty. This Crown Warranty is not extended by the length of time which you are deprived of the use of the new Crown product. Repairs and replacement parts provided under the terms of this Crown Warranty shall carry only the unexpired portion of this Crown Warranty.

**DESIGN CHANGES**

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

**LEGAL REMEDIES OF PURCHASER**

No action to enforce this Crown Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

**THIS STATEMENT OF WARRANTY SUPERSEDES ANY OTHERS CONTAINED IN THIS MANUAL FOR CROWN PRODUCTS.**

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*Telephone: 219-294-8200. Facsimile: 219-294-8301*

## NORTH AMERICA

**SUMMARY OF WARRANTY**

The Crown Audio Division of Crown International, Inc., 1718 West Mishawaka Road, Elkhart, Indiana 46517-4095 U.S.A. warrants to you, the ORIGINAL PURCHASER and ANY SUBSEQUENT OWNER of each NEW Crown product, for a period of three (3) years from the date of purchase by the original purchaser (the "warranty period") that the new Crown product is free of defects in materials and workmanship. We further warrant the new Crown product regardless of the reason for failure, except as excluded in this Warranty.

**ITEMS EXCLUDED FROM THIS CROWN WARRANTY**

This Crown Warranty is in effect only for failure of a new Crown product which occurred within the Warranty Period. It does not cover any product which has been damaged because of any intentional misuse, accident, negligence, or loss which is covered under any of your insurance contracts. This Crown Warranty also does not extend to the new Crown product if the serial number has been defaced, altered, or removed.

**WHAT THE WARRANTOR WILL DO**

We will remedy any defect, regardless of the reason for failure (except as excluded), by repair, replacement, or refund. We may not elect refund unless you agree, or unless we are unable to provide replacement, and repair is not practical or cannot be timely made. If a refund is elected, then you must make the defective or malfunctioning product available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers or at the factory. We will remedy the defect and ship the product from the service center or our factory within a reasonable time after receipt of the defective product at our authorized service center or our factory. All expenses in remedying the defect, including surface shipping costs in the United States, will be borne by us. (You must bear the expense of shipping the product between any foreign country and the port of entry in the United States and all taxes, duties, and other customs fees for such foreign shipments.)

**HOW TO OBTAIN WARRANTY SERVICE**

You must notify us of your need for warranty service not later than ninety (90) days after expiration of the warranty period. All components must be shipped in a factory pack, which, if needed, may be obtained from us free of charge. Corrective action will be taken within a reasonable time of the date of receipt of the defective product by us or our authorized service center. If the repairs made by us or our authorized service center are not satisfactory, notify us or our authorized service center immediately.

**DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES**

YOU ARE NOT ENTITLED TO RECOVER FROM US ANY INCIDENTAL DAMAGES RESULTING FROM ANY DEFECT IN THE NEW CROWN PRODUCT. THIS INCLUDES ANY DAMAGE TO ANOTHER PRODUCT OR PRODUCTS RESULTING FROM SUCH A DEFECT. **SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.**

**WARRANTY ALTERATIONS**

No person has the authority to enlarge, amend, or modify this Crown Warranty. This Crown Warranty is not extended by the length of time which you are deprived of the use of the new Crown product. Repairs and replacement parts provided under the terms of this Crown Warranty shall carry only the unexpired portion of this Crown Warranty.

**DESIGN CHANGES**

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

**LEGAL REMEDIES OF PURCHASER**

THIS CROWN WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. No action to enforce this Crown Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

**THIS STATEMENT OF WARRANTY SUPERSEDES ANY OTHERS CONTAINED IN THIS MANUAL FOR CROWN PRODUCTS.**

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The information furnished in this manual does not include all of the details of design, production, or variations of the equipment. Nor does it cover every possible situation which may arise during installation, operation or maintenance. If your unit bears the name "Amcron," please substitute it for the name "Crown" in this manual. If you need special assistance beyond the scope of this manual, please contact our Technical Support Group.

**Crown Technical Support Group**
Plant 2 SW, 1718 W. Mishawaka Rd., Elkhart, Indiana 46517 U.S.A.
Phone: **800-342-6939** (North America, Puerto Rico and Virgin Islands) or 219-294-8200
Fax: 219-294-8301 Internet: http://www.crownaudio.com

# IMPORTANT

**CLASS 1 OUTPUT WIRING REQUIRED. COMPLY WITH LOCAL ELECTRICAL CODES WHEN WIRING THIS DEVICE.**

**CAUTION**
**RISK OF ELECTRIC SHOCK DO NOT OPEN**

**TO PREVENT ELECTRIC SHOCK DO NOT REMOVE TOP OR BOTTOM COVERS. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL. DISCONNECT POWER CORD BEFORE REMOVING REAR INPUT MODULE TO ACCESS GAIN SWITCH.**

**AVIS**
**RISQUE DE CHOC ÉLECTRIQUE N'OUVREZ PAS**

**À PRÉVENIR LE CHOC ÉLECTRIQUE N'ENLEVEZ PAS LES COUVERCLES. IL N'Y A PAS DES PARTIES SERVICEABLE À L'INTÉRIEUR. TOUS REPARATIONS DOIT ETRE FAIRE PAR PERSONNEL QUALIFIÉ SEULMENT. DÉBRANCHER LA BORNE AVANT D'OUVRIR LA MODULE EN ARRIÈRE.**

# WARNING

**TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE!**

## Magnetic Field

**CAUTION! Do not locate sensitive high-gain equipment such as preamplifiers or tape decks directly above or below the unit.** Because this amplifier has a high power density, it has a strong magnetic field which can induce hum into unshielded devices that are located nearby. The field is strongest just above and below the unit.

If an equipment rack is used, we recommend locating the amplifier(s) in the bottom of the rack and the preamplifier or other sensitive equipment at the top.

The lightning bolt triangle is used to alert the user to the risk of electric shock.

The exclamation point triangle is used to alert the user to important operating or maintenance instructions.

Printed on recycled paper.

# Important Safety Instructions

1) Read these instructions.
2) Keep these instructions.
3) Heed all warnings.
4) Follow all instructions.
5) Do not use this apparatus near water.
6) Clean only with a dry cloth.
7) Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
8) Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus that produce heat.
9) Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding-type plug has two blades and a third grounding prong. The wide blade or the third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
10) Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
11) Only use attachments/accessories specified by the manufacturer.

12) Use only with a cart, stand, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
13) Unplug this apparatus during lightning storms or when unused for long periods of time.
14) Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.
15) To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.

# CONTENTS

**1 Welcome ..... 7**
1.1 Unpacking ..... 7
1.2 Features ..... 8

**2 Facilities ..... 9**

**3 Installation ..... 11**
3.1 Mounting ..... 11
3.2 Cooling ..... 11
3.3 Wiring ..... 12
3.3.1 Stereo (Two-Channel) Operation ..... 12
3.3.2 Bridge-Mono Operation ..... 13
3.3.3 Parallel-Mono Operation ..... 14
3.3.4 Input Connection ..... 15
3.3.5 Output Connection ..... 17
3.3.6 Additional Load Protection ..... 19
3.3.7 AC Power Requirements ..... 19

**4 Operation ..... 20**
4.1 Precautions ..... 20
4.2 Indicators ..... 20
4.3 Protection Circuits ..... 21
4.3.1 Output Device Emulation Protection (ODEP) ..... 21
4.3.2 Standby Mode ..... 22
4.3.3 Transformer Thermal Protection ..... 22
4.3.4 Circuit Breaker ..... 22
4.4 Controls ..... 23
4.5 Filter Cleaning ..... 24

**5 Technical Information ..... 25**
5.1 Overview ..... 25
5.2 VZ Power ..... 25
5.2.1 Background ..... 25
5.2.2 The VZ Supply ..... 26
5.3 Circuit Theory ..... 26
5.3.1 Stereo Operation ..... 26
5.3.2 Bridge-Mono Operation ..... 28
5.3.3 Parallel-Mono Operation ..... 28

**6 Specifications ..... 29**

**7 AC Power Draw and Thermal Dissipation ..... 36**

**8 Accessories ..... 37**
8.1 PIP Modules ..... 37
8.2 Level Control Security Kit ..... 39

**9 Service ..... 40**
9.1 Worldwide Service ..... 40
9.2 North American Service ..... 40
9.2.1 Service at a North American Service Center ..... 40
9.2.2 Factory Service ..... 40

# ILLUSTRATIONS


1.1 Macro-Tech 3600VZ Amplifier ..... 7
2.1 Front Facilities ..... 9
2.2 Rear Facilities ..... 10
3.1 Mounting Dimensions ..... 11
3.2 Top View of a Rack-Mounted Unit ..... 11
3.3 Proper Air Flow in a Rack Cabinet ..... 11
3.4 Stereo Wiring ..... 12
3.5 Bridge-Mono Wiring ..... 13
3.6 Parallel-Mono Wiring ..... 14
3.7 Unbalanced Input Wiring ..... 15
3.8 Balanced Input Wiring ..... 15
3.9 Balanced and Unbalanced Phone Plugs ..... 15
3.10 Subsonic Filter Capacitors ..... 16
3.11 Unbalanced RFI Filters ..... 16
3.12 Balanced RFI Filters ..... 16
3.13 Wire Size Nomograph ..... 17
3.14 Inductive Load (Transformer) Network ..... 18
3.15 Loudspeaker Fuse Nomograph ..... 19
4.1 Indicators ..... 20
4.2 Macro-Tech Indicator States ..... 21
4.3 Input Sensitivity and Ground Lift Switches ..... 23
5.1 A Typical Power Supply ..... 26
5.2 Music Waveforms are Complex ..... 26
5.3 VZ Supply in Parallel Mode ..... 26
5.4 VZ Supply in Series Mode ..... 26
5.5 Circuit Block Diagram ..... 27
6.1 Minimum Power Matrix ..... 32
6.2 Maximum Power Matrix ..... 33
6.3 Typical Frequency Response ..... 34
6.4 Typical Damping Factor ..... 34
6.5 Typical Output Impedance ..... 34
6.6 Typical Phase Response ..... 35
6.7 Typical Crosstalk ..... 35
7.1 Power Draw, Current Draw and Thermal Dissipation ..... 36
8.1 Installing a PIP Module ..... 37
8.2 PIP2 Adapter Connection ..... 37
8.3 Installing a PIP2 Module ..... 37
8.4 Installing a Level Control Shaft Lock ..... 39

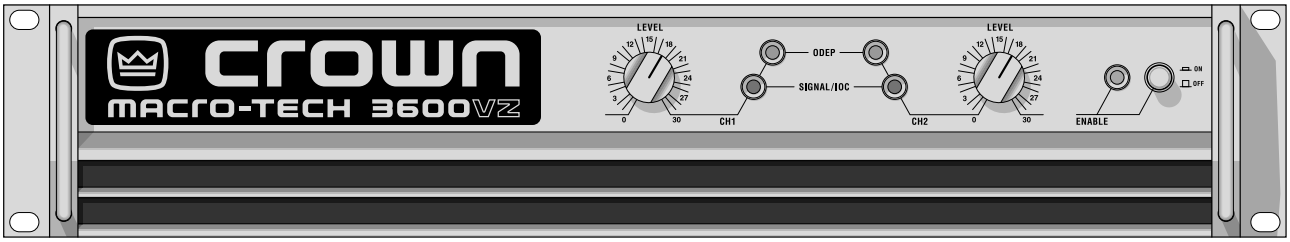



*Fig. 1.1 Macro-Tech 3600VZ Amplifier*

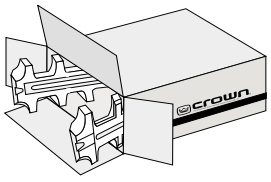
# 1 Welcome

Congratulations on your purchase of the *Macro-Tech® 3600VZ* professional power amplifier. It is the first audio amplifier to offer Crown's patented Variable Impedance (VZ®) power supplies. The new power supplies, along with new semiconductor technology, enable the Macro-Tech 3600VZ to pack more power into a mere 3½ inches of vertical rack space than ever before. Because it's a Macro-Tech, you have the added benefit of PIP ™compatibility for access to custom input modules and ODEP® protection to keep the show going long after other amplifiers would fail (see the Section 8 for available input modules).

This manual will help you successfully install and use your new amplifier. We strongly recommend you read all instructions, warnings and cautions contained within. Be sure to read Sections 3.3.2 and 3.3.3 if you plan to use the amplifier in one of its two mono modes. Also for your protection, please send in your warranty registration card today and save your bill of sale since it is your official proof of purchase.

## 1.1 Unpacking

Please unpack and inspect your new amplifier for any damage that may have occurred during transit. If damage is found, notify the transportation company immediately. Only you, the consignee, may initiate a claim with the carrier for damage resulting during shipment. Crown will be happy to cooperate fully as needed. Save the shipping carton as evidence of damage for the shipper's inspection.




Even if the unit arrived in perfect condition, as most do, save all packing materials so you will have them if you ever need to transport the unit. **NEVER SHIP THE UNIT WITHOUT THE FACTORY PACK.**

## 1.2 Features

The Macro-Tech 3600VZ amplifier uses the latest technology and miniaturized design to deliver the highest power and value for its size, weight and price. Crown's Grounded Bridge™ output and patented ODEP protection circuitry combine to provide performance and reliability that surpass all conventional amplifier designs. Macro-Tech amplifiers also have an independent high voltage power supply for each channel. This design provides ultra-low crosstalk specifications and makes it possible to treat each channel as a separate amplifier. Features:

- ❑ Crown's Grounded Bridge™circuitry generates incredible voltage swings while avoiding stressful output transistor configurations common to conventional amplifiers. The results are lower distortion and superior reliability.
- ❑ Patented ODEP (Output Device Emulation Protection) circuitry compensates for overheating and overload to keep the amplifier working long after others would fail.
- ❑ IOC® (Input/Output Comparator) circuitry immediately alerts of any distortion exceeding 0.05%, providing dynamic *proof of performance*.
- ❑ PIP (Programmable Input Processor) connector accepts accessories that tailor your amplifier to suit individual applications.
- ❑ Two mono modes (Bridge-Mono and Parallel-Mono) for driving a wide range of load impedances.
- ❑ Very low harmonic and intermodulation distortion result in the best *dynamic transfer function* in the industry.
- ❑ High damping factor provides superior control over low frequency drivers for a clean, accurate low end.
- ❑ An articulated VZ power supply for each channel provides excellent crosstalk characteristics and the best power matching to your load.
- ❑ Full protection against shorted outputs, open circuits, mismatched loads, general overheating, high frequency overloads and internal faults; loudspeaker protection against low frequency and DC output.
- ❑ Extra rugged, extruded aluminum front panel with ODEP and Signal Presence/IOC indicators for each channel, as well as an Enable Indicator.
- ❑ Separate voltage supplies for each channel provide low crosstalk and improved reliability.
- ❑ Efficient heat sinks and a self-contained forced air cooling system dissipate heat quickly and evenly to prevent overheating, prolong component life and deliver greater power output.
- ❑ Balanced inputs and adjustable front panel level controls.
- ❑ 31 detents in the level controls reduce the likelihood of settings being inadvertently disturbed.
- ❑ Ground lift switch to isolate chassis and phone jack audio input grounds.
- ❑ Multiple dual binding posts provide easy and versatile output connection.
- ❑ Internal three position input sensitivity switch provides settings of 0.775 volts and 1.4 volts for rated output, and 26 dB voltage gain.
- ❑ Mounts in a standard 19 inch (48.3 cm) equipment rack with rear support, or units can be stacked.
- ❑ All specifications are guaranteed for the duration of the warranty period.
- ❑ Units in North America and other select countries are covered by a three year "No-Fault" full warranty which completely protects your investment and guarantees its specifications.

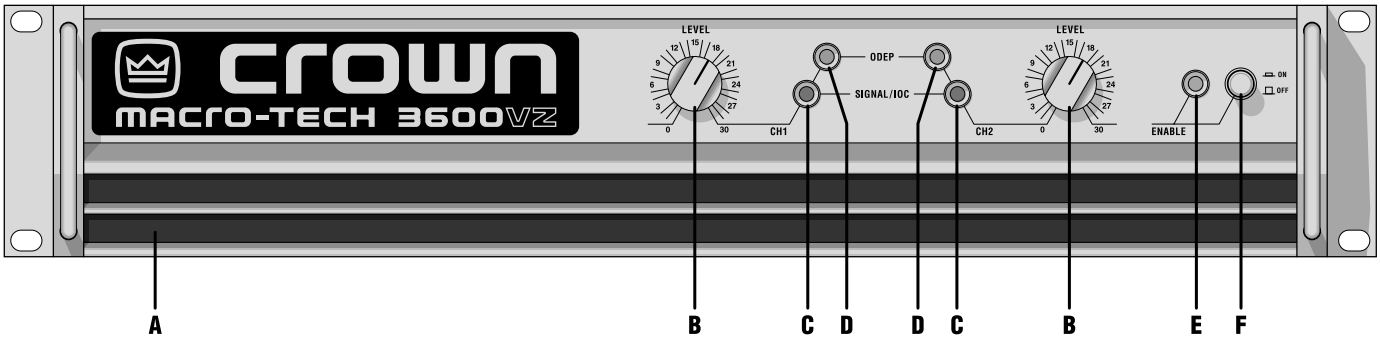



*Fig. 2.1 Front Facilities*

# 2 Facilities

## A. Dust Filter

The dust filters remove large particles from the air at the air intake. Check filters regularly to be sure they do not become clogged. The filter elements can be easily removed for cleaning by gently pulling them away from the front panel (see Sections 3.2 and 4.5).

## B. Level Controls

The level for each channel is set with these convenient controls mounted on the front panel. Each level control has 31 detents for precise adjustment (see Section 4.4). A security option is available to prevent tampering (see Section 8.2).

## C. Signal / IOC Indicators

The presence of an audio signal and the distortion level of each channel is represented by these green multi-function indicators. As signal presence indicators, they flash with normal intensity in sync with the output audio signal to indicate its presence. As IOC (Input/Output Comparator) indicators, they compare the waveform of the input signal to that of the output. They flash brightly with a 0.1 second hold delay if there is a difference (or distortion) of 0.05% or more. Another IOC function is to indicate input overload. If the input signal is too large the indicators will flash brightly (with a 0.5 second hold delay) to indicate input clipping distortion. *Note: The Channel 2 IOC indicator will stay on in Parallel-Mono mode* (refer to Section 4.2).

## D. ODEP Indicators

During normal operation of the Output Device Emulation Protection circuitry, these indicators glow brightly to show the presence of reserve thermodynamic energy. They dim proportionally as energy reserves decrease. In the event that energy reserves are depleted, the indicators turn off and ODEP proportionally limits output drive so the amplifier can safely continue to operate even under severe conditions. These indicators can also help to identify more unusual operating problems (see Section 4.2).

## E. Enable Indicator

This indicator lights when the amplifier has been "enabled" or turned on, and AC power is available (see Section 4.2).

## F. Enable Switch

Depress this push-button to turn the amplifier on or off. When turned on, the output is muted for approximately four seconds to protect your system from start-up transients. (This delay can be changed. Contact the Crown Technical Support Group for details.)

## G. Power Cord

All 120 VAC, 60 Hz North American units include a NEMA TT30P plug. These units also include 30-amp (10 AWG) line cord. Other units are equipped with a power cord and plug that is appropriate for the voltage requirements of the amplifier.

## H. Stereo/Mono Switch

The three operating modes of this amplifier are controlled by this switch. Stereo mode is available for normal two-channel operation. Bridge-Mono mode is available to drive a single load with an impedance equal to or greater than 4 ohms. Parallel-Mono mode is

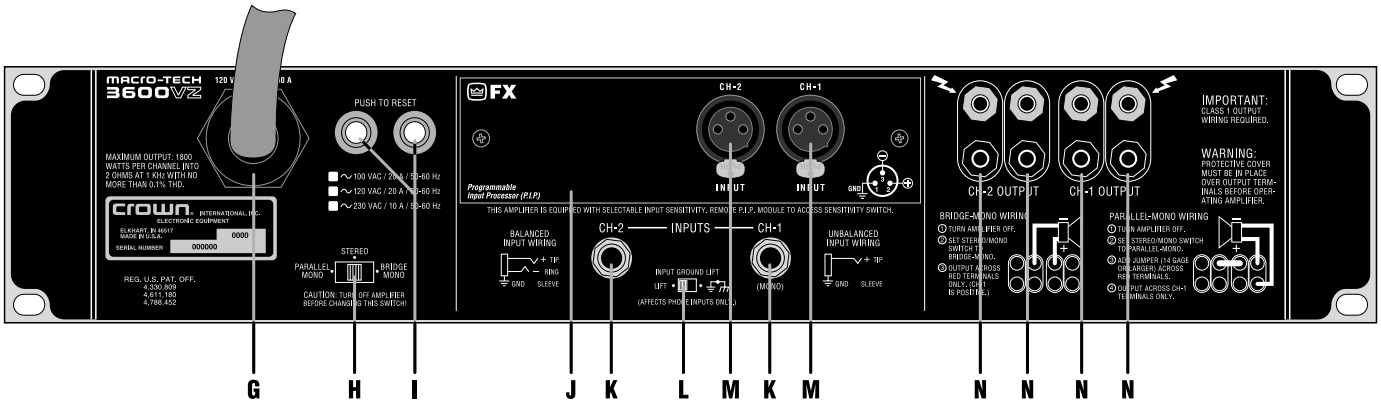



*Fig. 2.2 Rear Facilities*

available to drive a single load with an impedance less than 4 ohms. **Important: Do NOT change this switch unless the amplifier is first turned off** (see Section 3.3).

## I. Reset Buttons (PUSH TO RESET)

These reset buttons are used to reset the breakers that safeguard the power supplies from overload (see Section 4.3).

## J. PIP Module

Versatile Programmable Input Processor modules provide flexible expansion features that can be added to customize the amplifier. PIP modules plug into the connector inside the back panel of the amplifier. A PIP module's input connectors are placed in parallel with the input phone jacks. The P.I.P.®-FX is included as a standard feature to provide balanced XLR inputs. It has no internal circuitry and can be used along with the input phone jacks to facilitate "daisy chaining" multiple amplifiers. See Section 8 for a list of available PIP modules.

## K. Balanced Phone Jack Inputs

A balanced ¼ inch phone jack is provided for input to each channel. They may be used with either balanced (tip, ring and sleeve) or unbalanced (tip and sleeve) input wiring (refer to Section 3.3). Because these inputs are in parallel with the PIP connector, they should not be used as inputs if the installed PIP has active circuitry. **Caution: The Channel 2 input should NOT be used in either mono mode.**

## L. Ground Lift Switch

The input signal ground may be isolated from the AC ground with this switch to help prevent the hum created by unwanted ground loops. It affects only the input phone jacks. It has no affect on the PIP module's XLR input connectors. Activating the switch inserts an impedance between the sleeve of each phone input jack and the circuit ground.

## M. Balanced XLR Inputs

A balanced 3-pin female XLR connector is provided for input to each channel by the P.I.P.-FX, a standard feature of your amplifier. The XLR connectors are in parallel with the amplifier's phone jacks. Because there is no active circuitry on the PIP, the XLR connectors can be used at the same time as the phone input jacks for "daisy chaining" multiple amplifiers. **Caution: The Channel 2 input should NOT be used in either mono mode.**

## N. Output Jacks

Two pairs of dual binding posts are provided for the output of each channel so multiple loudspeakers can be connected easily. The connectors accept bare wire or spade lugs.

## ❑ Input Sensitivity Switch

The three position input sensitivity switch inside the amplifier can be accessed by removing the PIP module. Settings include 0.775 volts and 1.4 volts for rated output, and 26 dB voltage gain (see Section 4.4).

# 3 Installation

## 3.1 Mounting

Macro-Tech amplifiers are designed for standard 19 inch (48.3 cm) rack mounting and "stack" mounting without a cabinet. In a rack cabinet, it is best to mount them one on top of the other. This provides efficient air flow and enables each unit to support the one above.

**Important:** Due to its weight, the back of the amplifier should be supported.

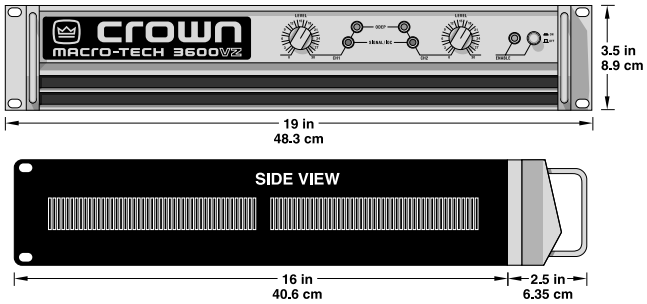



*Fig. 3.1 Mounting Dimensions*

## 3.2 Cooling

NEVER block the amplifier's side vents and front air intake. Under demanding conditions, there should be a minimum air flow of 45 cubic feet (1.3 cubic meters) per minute per amplifier. When mounted in a rack, all empty spaces should be covered with blank panels to prevent improper air flow. The amplifier's air flow should be augmented with a rack cooling system if its load is less than 4 ohms and it must operate at consistently high output levels as in concert sound reinforcement.

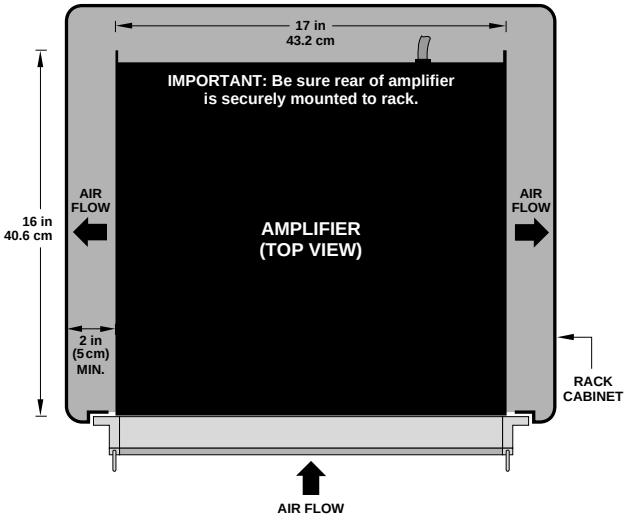



*Fig. 3.2 Top View of a Rack-Mounted Unit*

When mounting the amplifier in a rack cabinet, the side walls of the rack should be at least 2 inches (5 cm) away from the chassis as shown in Figure 3.2.

***Tip:*** An easy way to verify adequate cooling is to observe the ODEP indicators with the amplifier operating under worst-case conditions. If the indicators dim, additional cooling is recommended.

If your rack cabinet has a front door that could block air flow to the amplifier's air intakes, you must provide adequate air flow either with a grille in the door or by pressurizing the air behind the door. Wire grilles are recommended over perforated panels because they have larger openings and cause less restriction.

A good choice for increased air flow behind a rack cabinet door is to mount one or more "squirrel cage" blowers in the rack (Option 1 below). The blower is mounted at the bottom of the rack so it blows outside air into the space between the door and the front of the amplifiers. This blower should not blow air into or take air out of the space behind the amplifiers. For racks without a door, mount a blower at the top of the rack so air is drawn out the back (Option 2 below). The blower must provide air flow that exceeds the sum of the air flow required by the individual amplifiers.

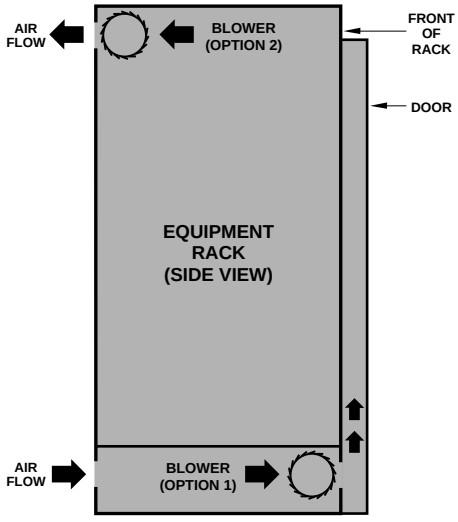



*Fig. 3.3 Proper Air Flow in a Rack Cabinet*

If the air supply is unusually dusty, it may be necessary pre-filter it using commercial furnace filters, etc., to prevent rapid loading of the unit's own air filter. When needed, the unit's filter can be cleaned with mild dish detergent and water (see Section 4.5).

## 3.3 Wiring

The following section describes common ways to install your amplifier in a sound system. The input and output terminals are located on the rear panel. Please use care when making connections, selecting signal sources and controlling the output level. The load you save may be your own! Crown assumes no liability for damaged loads resulting from careless amplifier use or deliberate overpowering.

**CAUTION: Always remove power from the unit and turn the level controls off when making or breaking connections**—especially if the load is a loudspeaker system. This reduces the chance of loud blasts or damaged loudspeakers.

Macro-Tech amplifiers may be operated in one of three modes (Stereo, Bridge-Mono, and Parallel-Mono) by switching the Stereo/Mono switch on the rear panel. There are VERY IMPORTANT wiring differences between these three modes which are discussed next.

### 3.3.1 Stereo (Two-Channel) Operation

The installation is very intuitive in Stereo mode. The input of Channel 1 feeds the output of the same channel as does the input of Channel 2. To put the amplifier into Stereo mode, first turn the amplifier off, then slide the Stereo/Mono switch to the center position, and properly connect the output wiring as shown in Figure 3.4. Two sets of binding posts are provided for each channel to facilitate easy connection of multiple speakers to each channel. Observe correct loudspeaker polarity and be very careful not to short the outputs of one channel to that of the other channel while in Stereo mode.

**CAUTION: In Stereo mode, never parallel the two outputs by directly tying them together or paralleling them with the output of any other amplifier.**

Such connection does not result in increased power output and can cause premature activation of the protection circuitry to prevent overheating.

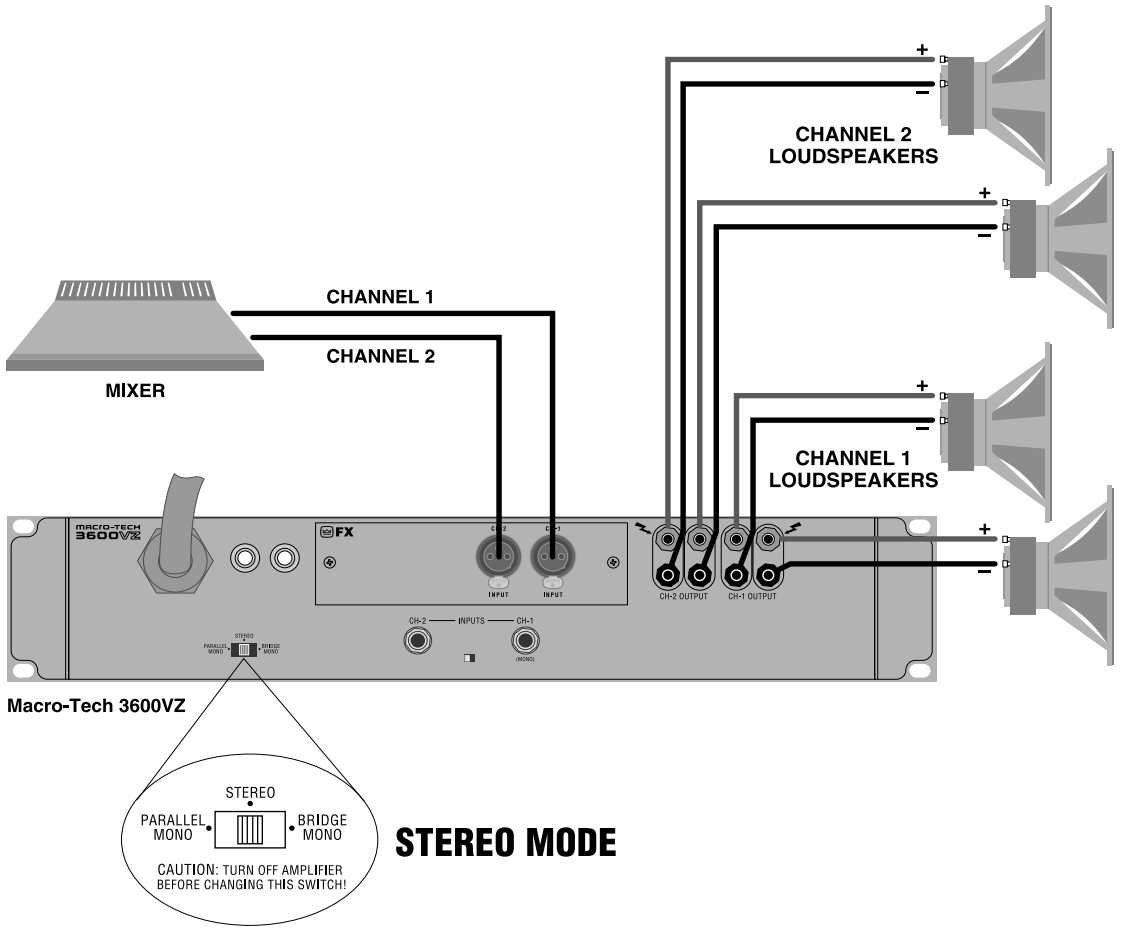



*Fig. 3.4 Stereo Wiring*

### 3.3.2 Bridge-Mono Operation

Bridge-Mono mode is intended for driving loads with a net impedance of 4 ohms or greater. (See Parallel-Mono if the load is less than 4 ohms.) Installing the amplifier in Bridge-Mono mode is very different from the other modes and requires special attention.

To put the amplifier in Bridge-Mono mode, turn the amplifier off and slide the Stereo/Mono switch toward the right (as you face the back of the amplifier). Both outputs receive the signal from Channel 1 with the output of Channel 2 inverted so it can be bridged with the Channel 1 output. DO NOT USE THE CHANNEL 2 INPUT or the signal level and quality may be greatly degraded. Keep the Level control of Channel 2 turned completely down (counterclockwise).

Note: The input jack and level control for Channel 2 are not defeated in Bridge-Mono mode. Any signal fed into Channel 2 may work against and add to or distort the signal in Channel 1.

Connect the load across the Channel 1 and 2 red binding posts with the positive lead from the load attaching to a red post of Channel 1 and the negative lead of the load attaching to a red post of Channel 2 as shown in Figure 3.5. THE TWO BLACK BINDING POSTS ARE NOT USED AND SHOULD NOT BE SHORTED. The load must be balanced (neither side shorted to ground).

**CAUTION: Be certain all equipment (meters, switches, etc.) connected to the mono output is balanced. To prevent oscillations, both sides of the line must be isolated from the input grounds.**

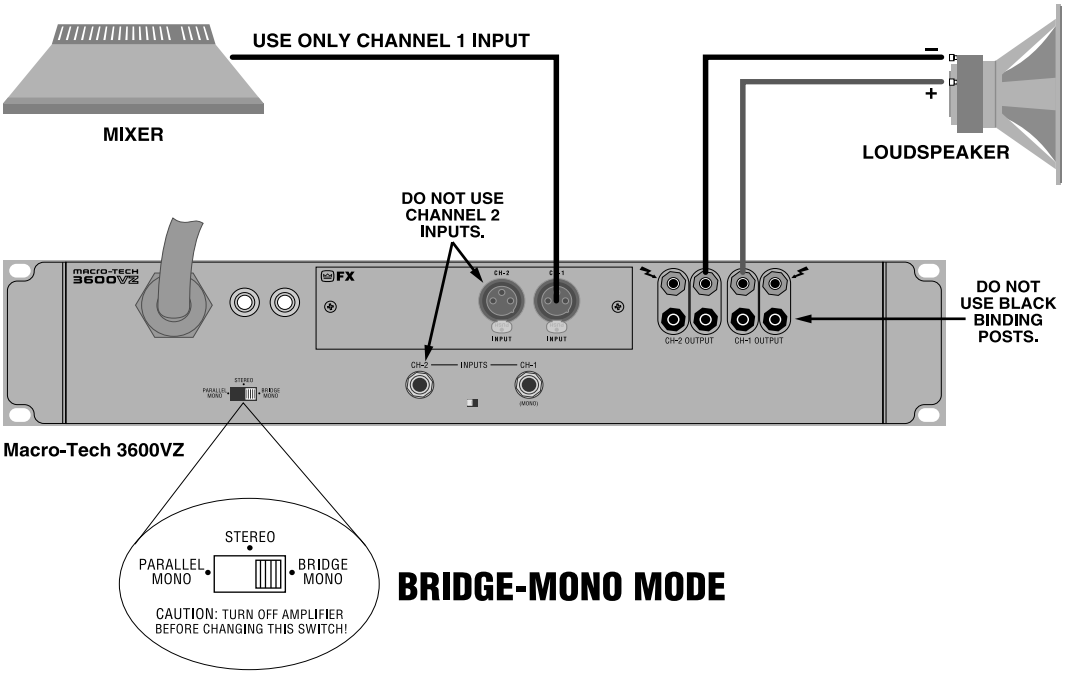



*Fig. 3.5 Bridge-Mono Wiring*

### 3.3.3 Parallel-Mono Operation

Parallel-Mono mode is used to drive loads with a total impedance of less than 4 ohms. (See Bridge-Mono if the load is 4 ohms or greater.) Installing the amplifier in Parallel-Mono mode is very different from the other modes and requires special attention.

**CAUTION: Do not attempt to operate in Stereo or Bridge-Mono mode until the Parallel-Mono jumper is first removed. Failure to do so will definitely cause inefficient operation, high distortion and excessive heating.**

To put the amplifier in Parallel-Mono mode, first turn it off, then slide the Stereo/Mono switch to the left (as you face the back). Connect the input signal to Channel 1 only. DO NOT USE THE CHANNEL 2 INPUT or the signal level and quality may degrade greatly. Turn off the Channel 2 Level control (full counterclockwise).

Note: It is normal for the IOC indicator of Channel 2 to stay on in Parallel-Mono mode.

The input jack and Level control of Channel 2 are not defeated in Parallel-Mono mode. Any signal fed into Channel 2 may work against and add to or distort the signal in Channel 1.

Install a jumper wire between the red binding posts of both Channel 1 and 2 that is at least 14 gauge in size. Then, connect the load to the output of Channel 1 as shown in Figure 3.6. The positive lead from the load connects to the red binding post of Channel 1 and the negative lead from the load connects to the black binding post of Channel 1.

**CAUTION: Remove the jumper wire before changing to any mode except Parallel-Mono.**

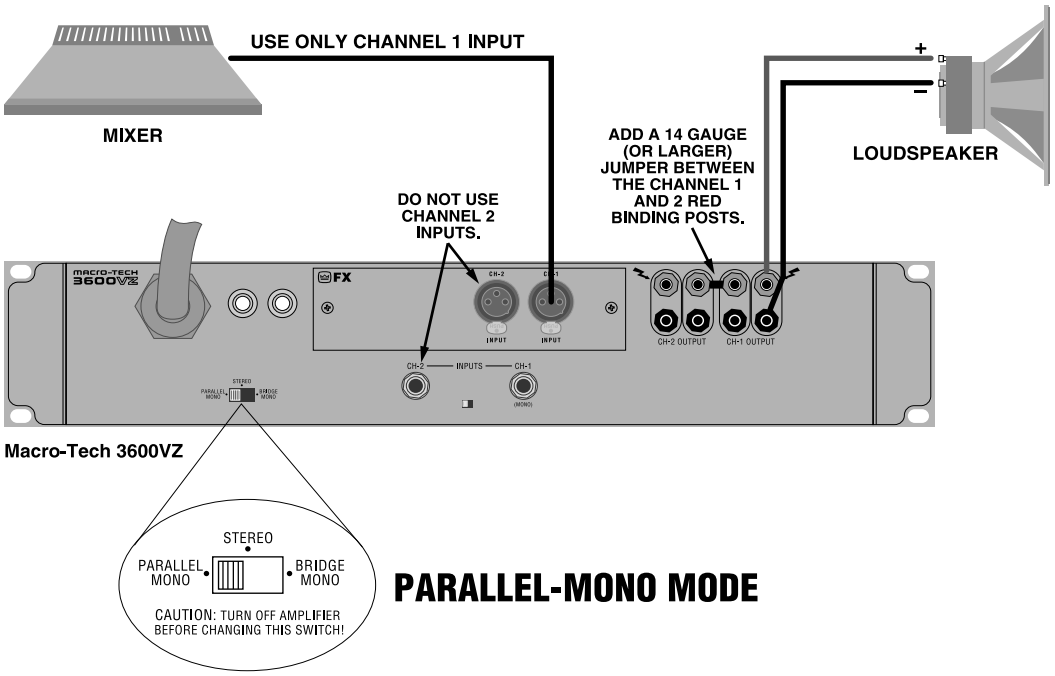



*Fig. 3.6 Parallel-Mono Wiring*

### 3.3.4 Input Connection

Both the balanced XLR and phone jack inputs have a nominal impedance of 20 k ohms (10 K ohms with unbalanced wiring) and will accept the line-level output of most devices. Female XLR input connectors are provided on the standard P.I.P.-FX input module (other *PIP* modules are described in Section 8.1). Correct input wiring will depend on two factors: (1) whether the input signals are balanced or unbalanced, and (2) whether the signal source floats or has a ground reference. Figures 3.7 and 3.8 show the recommended connection techniques for each type of signal source.

The amplifier's built-in ¼-inch phone jack input connectors can be wired similarly for balanced or unbalanced, floating or ground-referenced sources. They have a standard tip-ring-sleeve (TRS) configuration: the tip is positive (+), the ring is negative (–) and the sleeve is ground (see Figure 3.9). Wiring for various sources follows the XLR wiring guidelines shown in Figures 3.7 and 3.8.

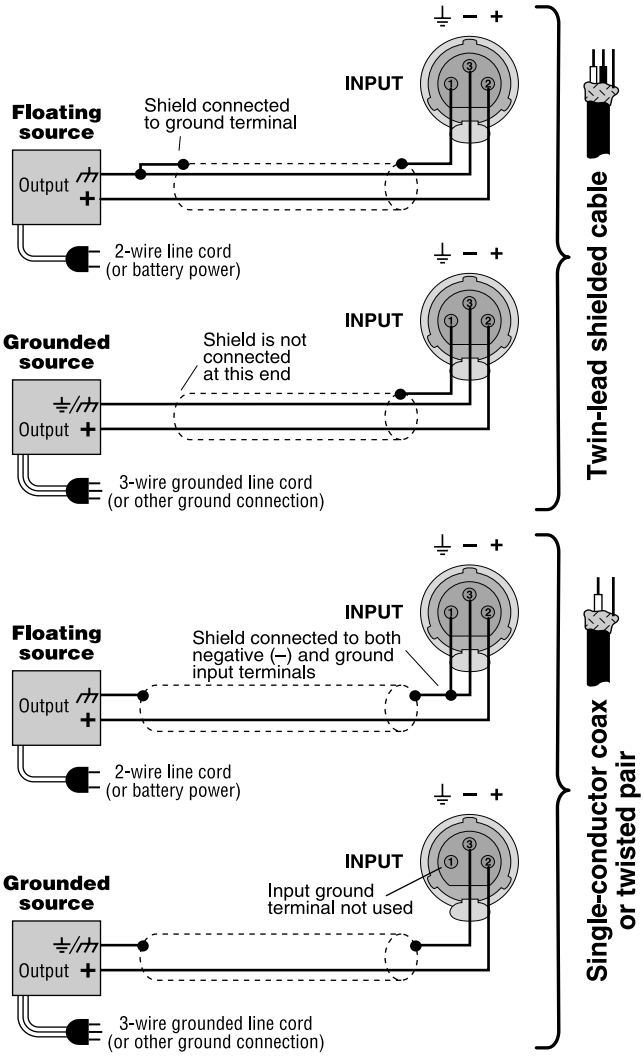

Floating source
Shield connected to ground terminal
INPUT
Output
2-wire line cord (or battery power)
Grounded source
Shield is not connected at this end
3-wire grounded line cord (or other ground connection)
Twin-lead shielded cable
Floating source
Shield connected to both negative (–) and ground input terminals
2-wire line cord (or battery power)
Grounded source
Input ground terminal not used
3-wire grounded line cord (or other ground connection)
Single-conductor coax or twisted pair

*Fig. 3.7 Unbalanced Input Wiring*

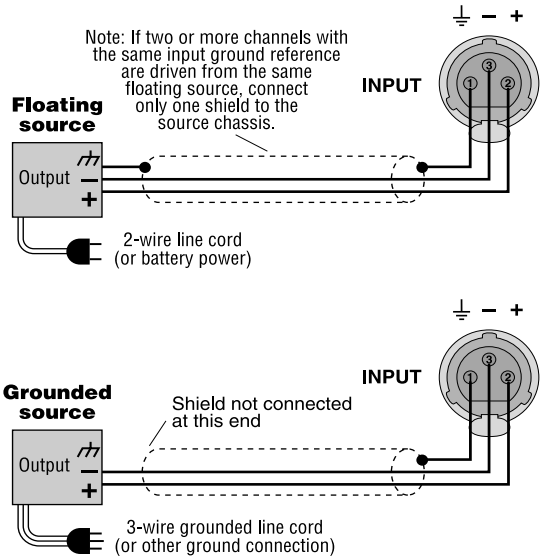

Note: If two or more channels with the same input ground reference are driven from the same floating source, connect only one shield to the source chassis.
Floating source
INPUT
Output
2-wire line cord (or battery power)
Grounded source
Shield not connected at this end
3-wire grounded line cord (or other ground connection)

*Fig. 3.8 Balanced Input Wiring*

The phone jacks should not be used as inputs when a *PIP* module with active circuitry is installed. The phone jacks are in parallel with the output of the *PIP* module, so an input signal connected to the phone jacks can feed backwards into the active circuitry of the *PIP* and cause undesirable distortion. You can use the phone jacks for signal input with any of the following *PIP* modules installed: P.I.P.-FX, P.I.P.-BB, P.I.P.-FMX, P.I.P.-FXQ and P.I.P.-FPX. All other *PIP* modules have active circuitry and should not be installed if you plan to connect input signals to the phone jacks. The phone jacks can always be used as "daisy chain" outputs to feed post-processed signals from the *PIP* to the inputs of other amplifiers.

Please follow the instruction in Section 3.3.2 and 3.3.3 if the amplifier will be used in either Bridge-Mono or Parallel-Mono mode. Remember, do not use the Channel 2 input in either mono mode.

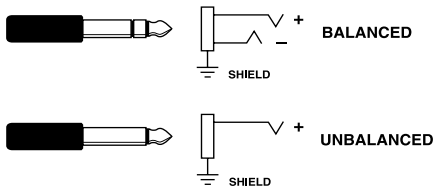



*Fig. 3.9 Balanced and Unbalanced Phone Plugs*

## SOLVING INPUT PROBLEMS

Sometimes large **subsonic** (subaudible) **frequencies** are present in the input signal. These can damage loudspeakers by overloading or overheating them. To attenuate such frequencies, place a capacitor in series with the input signal line. The graph in Figure 3.10 shows some capacitor values and how they affect the frequency response. Use only low-leakage paper, mylar or tantalum capacitors.

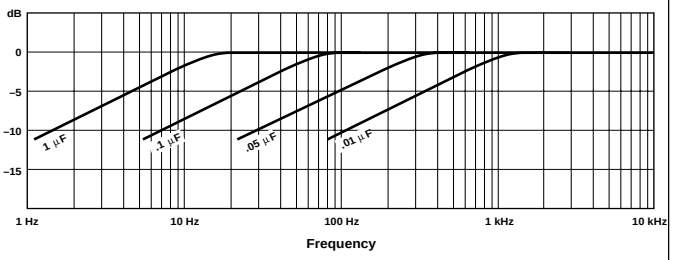



*Fig. 3.10 Subsonic Filter Capacitors*

Another problem to avoid is the presence of large levels of **radio frequencies** or RF in the input signal. Although high RF levels may not pose a threat to the amplifier, they can burn out tweeters or other loads that are sensitive to high frequencies. Extremely high RF levels can also cause your amplifier to prematurely activate its protection circuitry, resulting in inefficient operation. RF can be introduced into the signal by local radio stations and from the bias signal of many tape recorders. To prevent high levels of input RF, install an appropriate low-pass filter in series with the the input signal. Some examples of unbalanced wiring for low-pass filters are shown in Figure 3.11.

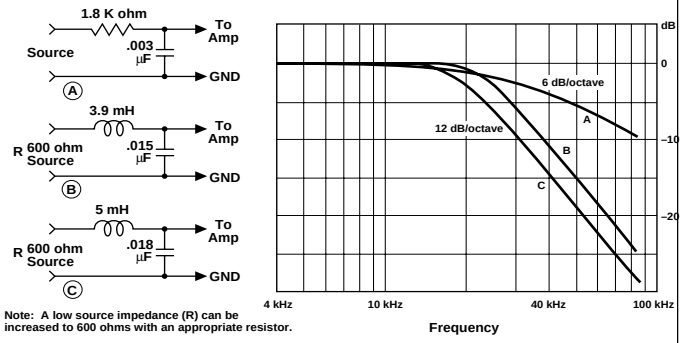



*Fig. 3.11 Unbalanced RFI Filters*

For balanced input wiring use one of the examples in Figure 3.12. Filters A, B and C correspond to the unbalanced filters above. Filter D also incorporates the subsonic filter described previously.

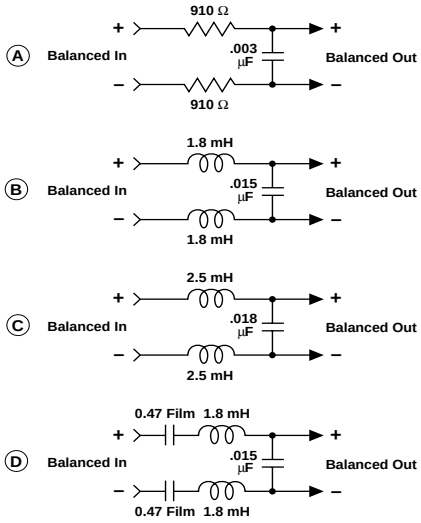



*Fig. 3.12 Balanced RFI Filters*

***Tip:** The P.I.P.-FX included with your amplifier has plenty of room on its circuit board for input filters.*

A third problem to avoid is **hum**. The two most common sources of hum in an audio system are **inductive coupling** and **ground loops**.

Inductive coupling can occur when input cables are subjected to a magnetic field from a power cord or power transformer. One way to prevent inductive coupling is to lace the input cables together along their length and route them as far away as possible from power transformers and power cords. The use of

### Input Wiring Tips

1. Use only shielded cable. Cables with higher density shields are better. Spiral wrapped shield is not recommended.

2. When using unbalanced lines, keep the cables as short as possible. Avoid cable lengths greater than 10 feet (3 meters).

3. Do not run signal cables together with high-level wiring such as loudspeaker wires or AC cords. This greatly lessens the chance of hum or noise being induced into the input cables.

4. Turn the entire system off before changing connections. Turn level controls down completely before powering the system back up. Crown is not liable for damage incurred when any transducer or component is overdriven.

shielded pair cable is another effective way to reduce or eliminate hum resulting from inductive coupling.

Ground loops often result when two or more devices are improperly grounded. This causes undesirable stray currents that may produce hum in the output. The best way to avoid ground loops is to ensure that all system devices are plugged into the same power strip. In addition, make sure that all cable shields are grounded at one end only.

Input and output grounds are sometimes tied together for testing or metering. This can cause **feedback oscillation** from load current in the test loop. In some systems, even the AC power line may provide this feedback path. Proper grounding, input isolation and isolation of common AC devices in the system is good practice.

### 3.3.5 Output Connection

Consider the power handling capacity of your load before connecting it to the amplifier. Crown is not liable for damage incurred at any time due to overpowering. Fusing loudspeaker lines is highly recommended (see Section 3.3.6). Also, please pay close attention to the precautions provided in Section 4.1.

#### Use Good Connectors

1. To prevent possible shorts, do not expose the loudspeaker cable connectors.
2. Do not use connectors that might accidentally tie two channels together when making or breaking connections (for example, a standard three-wire stereo phone plug).
3. Connectors that can be plugged into AC power receptacles should never be used.
4. Connectors with low current-carrying capacity should not be used.
5. Connectors with any tendency to short should never be used.

## HOW TO DETERMINE APPROPRIATE WIRE GAUGE

It is important to use loudspeaker cables with sufficient gauge (thickness) for the length being used. The resistance introduced by inadequate loudspeaker cables will reduce both the output power and the motion control of the loudspeakers. The latter problem occurs because the damping factor decreases as the cable resistance increases. This is very important because the amplifier's excellent damping factor can easily be negated by insufficient loudspeaker cables.

Use the nomograph in Figure 3.13 and the procedure that follows to find the recommended wire gauge (AWG or American Wire Gauge) for your system.

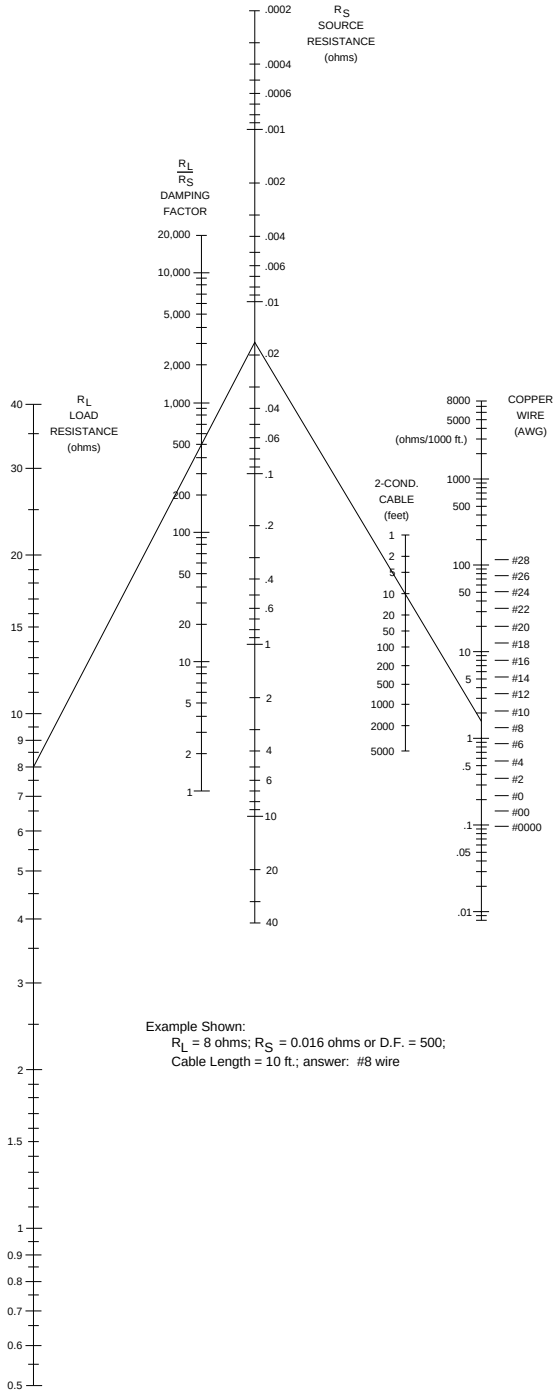

$R_S$ SOURCE RESISTANCE (ohms)
$\frac{R_L}{R_S}$ DAMPING FACTOR
$R_L$ LOAD RESISTANCE (ohms)
2-COND. CABLE (feet)
COPPER WIRE (AWG)
(ohms/1000 ft.)
Example Shown:
$R_L$ = 8 ohms; $R_S$ = 0.016 ohms or D.F. = 500;
Cable Length = 10 ft.; answer: #8 wire

*Fig. 3.13 Wire Size Nomograph*

1. Note the load resistance of the loudspeakers connected to each channel of the amplifier. Mark this value on the "Load Resistance" line of the nomograph.
2. Select an acceptable damping factor and mark it on the "Damping Factor" line. Your amplifier can provide an excellent damping factor of 1,000 from 10 to 400 Hz in Stereo mode with an 8-ohm load. In contrast, typical damping factors are 50 or lower. Higher damping factors yield lower distortion and greater motion control over the loudspeakers. A common damping factor for commercial applications is between 50 and 100. Higher damping factors may be desirable for live sound, but long cable lengths often limit the highest damping factor that can be achieved practically. (Under these circumstances, Crown's *IQ System*® is often used so amplifiers can be monitored and controlled when they are located very near the loudspeakers.) In recording studios and home hi-fi, a damping factor of 500 or more is very desirable.
3. Draw a line through the two points with a pencil, and continue until it intersects the "Source Resistance" line.
4. On the "2-Cond. Cable" line, mark the length of the cable run.
5. Draw a pencil line from the mark on the "Source Resistance" line through the mark on the "2-Cond. Cable" line, and on to intersect the "Annealed Copper Wire" line.
6. The required wire gauge for the selected wire length and damping factor is the value on the "Annealed Copper Wire" line. *Note: Wire size increases as the AWG gets smaller*.
7. If the size of the cable exceeds what you want to use, (1) find a way to use shorter cables, like using the *IQ System*, (2) settle for a lower damping factor, or (3) use more than one cable for each line. Options 1 and 2 will require the substitution of new values for cable length or damping factor in the nomograph. For option 3, estimate the effective wire gauge by subtracting 3 from the apparent wire gauge every time the number of conductors of equal gauge is doubled. So, if #10 wire is too large, two #13 wires can be substituted, or four #16 wires can be used for the same effect.

## SOLVING OUTPUT PROBLEMS

Sometimes **high-frequency oscillations** occur which can cause your amplifier to prematurely activate its protection circuitry and result in inefficient operation. The effects of this problem are similar to the effects of the RF problem described in Section 3.3.4. To prevent high-frequency oscillations:

1. Lace together the loudspeaker conductors for each channel; do not lace together the conductors from different channels. This minimizes the chance that cables will act like antennas and transmit or receive high frequencies that can cause oscillation.
2. Avoid using shielded loudspeaker cable.
3. Avoid long cable runs where the loudspeaker cables from different amplifiers share a common cable tray or cable jacket.
4. Never connect the amplifier's input and output grounds together.
5. Never tie the outputs of multiple amplifiers together.
6. Keep loudspeaker cables well separated from input cables.
7. Install a low-pass filter on each input line (similar to the RF filters described in Section 3.3.4.
8. Install input wiring according to the instructions in Section 3.3.4.

Another problem to avoid is the presence of large **subsonic currents** when primarily inductive loads are used. Examples of inductive loads are 70-volt transformers and electrostatic loudspeakers.

Inductive loads can appear as a short circuit at low frequencies. This can cause the amplifier to produce large low-frequency currents and activate its protection circuitry. Always take the precaution of installing a high-pass filter in series with the amplifier's input when inductive loads are used. A 3-pole, 18 dB per octave filter with a –3 dB frequency of 50 Hz is recommended (depending on the application, an even higher –3 dB frequency may be desirable). Such a filter is described with subsonic frequency problems in Section 3.3.4.

Another way to prevent the amplifier from prematurely activating its protection systems and to protect inductive loads from large low-frequency currents is to connect a 590 to 708 µF nonpolarized capacitor and 4-ohm, 20-watt resistor in series with the amplifier's output and the positive (+) lead of the transformer. The circuit shown below uses components that are available from most electronic supply stores.

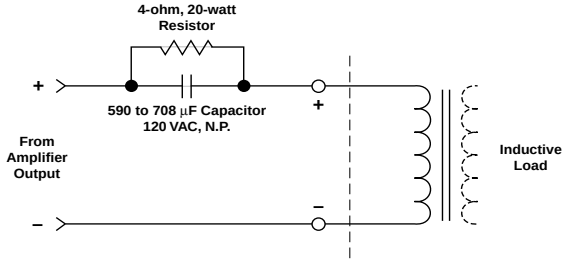



*Fig. 3.14 Inductive Load (Transformer) Network*

### 3.3.6 Additional Load Protection

Because the amplifier generates enormous power, it may be desirable to protect loudspeakers (or other sensitive loads) from damage due to excessive power. A common way to do this is to put a fuse in series with the load. This may be accomplished by using a single fuse to protect the entire system, or by fusing each driver.

Fuses help prevent damage due to prolonged overload, but provide essentially no protection against damage from large transients. To minimize this latter problem, use high-speed instrument fuses such as the Littlefuse 361000 series. If the loudspeaker is only susceptible to damage caused by prolonged overload (such as overheating), use a fuse or circuit breaker having the same slow thermal response as the loudspeaker itself (such as a slow-blow fuse).

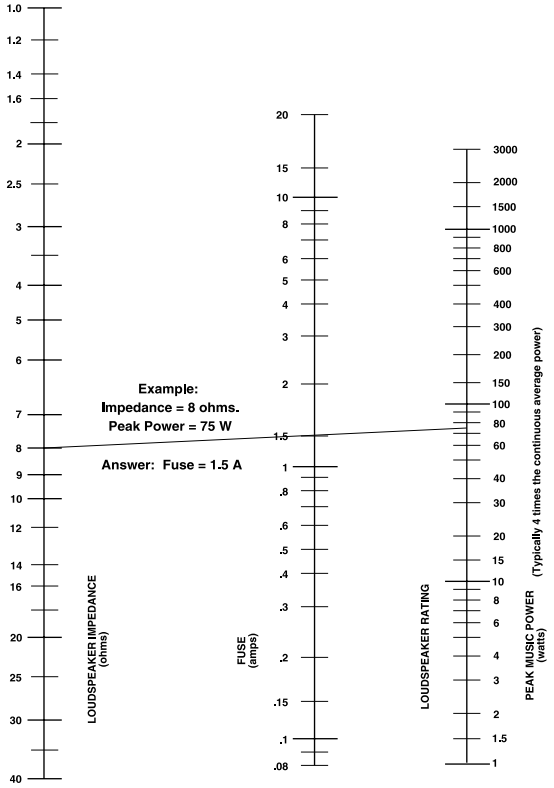



*Fig. 3.15 Loudspeaker Fuse Nomograph*

The nomograph in Figure 3.15 shows fuse size versus loudspeaker peak power rating. It can be used to determine the size of the required fuse.

### 3.3.7 AC Power Requirements

Use an isolated power receptacle whenever possible with adequate current. North American units are shipped with a 30 amp (10 AWG) line cord, a NEMA TT30P plug and a mating receptacle. International units may or may not be shipped with a plug connected to the appropriate line cord. Line voltages of 10% or more above the specified voltage may damage the amplifier.

# 4 Operation

## 4.1 Precautions

Although the Macro-Tech 3600VZ is protected from external faults, the following precautions should be followed for safety and optimum operation:

1. There are important differences among the Stereo, Bridge-Mono and Parallel-Mono operating modes (see Section 3.3).
2. **WARNING: Do not change the position of the Stereo/Mono switch unless the amplifier is first turned off.**
3. **CAUTION: In Parallel-Mono mode, a jumper is used between the Channel 1 and Channel 2 red binding posts (amplifier outputs). Be sure to remove this jumper for Bridge-Mono or Stereo mode; otherwise inefficient operation, high distortion and excessive heating will occur. Check the Stereo/Mono switch on the back panel for proper position.**
4. **Turn the amplifier off and unplug it from the AC mains before removing a *PIP* card.**
5. Use care when making connections, selecting signal sources and controlling the output level. The load you save may be your own.
6. Do not short the ground lead of an output cable to the input signal ground. This may form a ground loop and cause oscillations.
7. Operate the amplifier from AC mains of not more than 10% variation above or below the selected line voltage and only the specified line frequency.
8. **Never connect the output to a power supply output, battery or power main.**
9. Tampering in the circuit by unqualified personnel, or making unauthorized circuit changes may be extremely dangerous and may invalidate the warranty.

*Remember: Crown is not liable for damage that results from overdriving components in your system.*

## 4.2 Indicators

The front panel has several helpful LED (light emitting diode) indicators.

The amber **Enable indicator** is provided to show the amplifier has been turned on (or enabled) and that the low-voltage power supply is working. It does not indicate the high voltage supply status. As a result, disruption of the high voltage supplies has no effect on the Enable indicator. This means that in the improbable event that one or both channels overheat and cause a shut down of the high voltage power supply, the Enable indicator will remain on. However, the Signal/IOC indicator lights to show that the output waveform does not match the input.

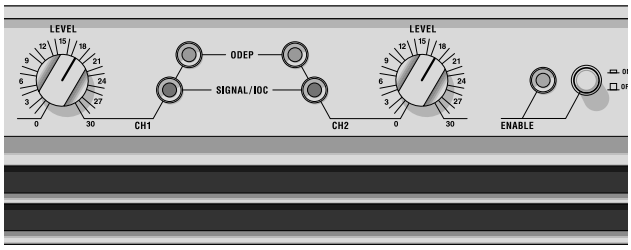



*Fig. 4.1 Indicators*

The **ODEP indicators** provide a visual indication of the operation of Crown's patented Output Device Emulation Protection (ODEP) circuitry. This circuitry protects the amplifier output stages against heat damage by proportionally limiting the drive level to the output stages. This enables the amplifier to operate safely even under severe operating conditions.

During normal operation, the ODEP indicators glow brightly to indicate that the output stages are operating within their thermal range (SOA - Safe Operating Area). However, if an output stage begins to overheat, the ODEP circuitry proportionally limits the drive signal and the LEDs dim. In the unlikely event that the amplifier exceeds the operating limits, ODEP shuts down the output stages and the indicators turn off. The indicators also turn off if the power supplies are put in standby mode.

Note: The high voltage power supplies will temporarily go into standby mode if their transformers get too hot or if there is DC or heavy common-mode current in the output.

The green **Signal/*IOC* indicators** provide the triple functions of Signal Presence, Distortion, and Input Overload indicators. As signal presence indicators, they flash with normal intensity in sync with the audio outputs. As IOC (Input/Output Comparator) indicators, they flash brightly if there is any difference between the input and output signal waveforms greater than 0.05%. Because transient distortion happens quickly, a 0.1 second "hold delay" keeps the indicators on long enough to be easily noticed. This IOC function verifies the

| Indicator Status | Amplifier Condition |
|---|---|
| ODEP — OFF<br>SIGNAL/IOC — OFF | **There is no power to the amplifier and all indicators are off, including the Enable light.** Possible reasons: (1) The amplifier's Enable switch is off. (2) The amplifier is not plugged into the power receptacle. (3) The AC circuit breaker has been tripped. (4) The amplifier's low-voltage power supply fuse has blown. |
| ODEP — ON<br>SIGNAL/IOC — OFF | **Normal operation for a channel with NO audio output.** Possible reasons: (1) There is no input signal. (2) The input signal level is very low. (3) The channel's level control is turned down. |
| ODEP — ON<br>SIGNAL/IOC — Normal | **Normal operation for a channel with audio output.** The *ODEP* indicator will remain at full intensity to show that there is reserve thermodynamic energy, and the Signal/*IOC* indicator will flash with normal intensity to show that the channel has audio output. |
| ODEP — ON<br>SIGNAL/IOC — Bright | **The channel's output is exceeding 0.05% distortion.** The input signal level is too high and *IOC* is reporting either an input overload or output clipping.<br>OR<br>**Channel 2 only: The amplifier is in Parallel-Mono mode.** The channel 2 Signal/*IOC* indicator always turns on to full brightness whenever the amplifier's stereo/mono switch is set to Parallel-Mono mode. |
| ODEP — OFF<br>SIGNAL/IOC — Bright | **The amplifier channel is in standby mode.** Possible reasons: (1) A PIP module like an *IQ–P.I.P.–SMT* has turned off the channel's high-voltage power supply. (2) The amplifier has just been turned on and is still in the four second turn-on delay. (3) The DC / low-frequency protection circuitry has been activated. (4) The fault protection circuitry has been activated. (5) The transformer thermal protection circuitry has been activated.<br>OR<br>**A channel's circuit breaker has tripped.** Transformer overload can cause a channel's circuit breaker to trip.<br>OR<br>***ODEP* limiting has been activated.** Possible reasons: (1) The amplifier's air filters are blocked and need to be cleaned. (2) There is insufficient cooling because of inadequate air flow or air that is too hot. (3) The load impedance for the channel is too low because the output is shorted or the amplifier is driving too many loudspeakers for the selected stereo/mono mode. (4) The amplifier channel is continuously being driven to very high output levels. |
| ODEP — OFF<br>SIGNAL/IOC — Normal | ***ODEP* limiting is about to begin.** Possible reasons: (1) The amplifier's air filters are blocked and need to be cleaned. (2) There is insufficient cooling because of inadequate air flow or air that is too hot. (3) The load impedance for the channel is too low because the output is shorted or the amplifier is driving too many loudspeakers for the selected stereo/mono mode. (4) The amplifier channel is continuously being driven to very high output levels. |

*Fig. 4.2 Macro-Tech Indicator States*

amplifier's performance. As input overload indicators, they flash brightly with a 0.5 second hold delay when an input signal that is too large begins to cause early clipping distortion at the input. *Note: the Channel 2 IOC indicator will stay on in Parallel-Mono mode.*

## 4.3 Protection Circuits

Macro-Tech amplifiers provide extensive protection and diagnostics capabilities. Protection systems include ODEP, "standby," and an AC circuit breaker. These features provide protection under any conditions.

### 4.3.1 Output Device Emulation Protection (ODEP)

Crown invented ODEP to solve two long standing problems in amplifier design: To prevent amplifier shutdown during demanding operation and to increase the efficiency of output circuitry.

To do this, Crown established a rigorous program to measure the *safe operating area* (SOA) of each output transistor before installing it in an amplifier. Crown also designed intelligent circuitry to simulate the instantaneous operating conditions of those output transistors.

Its name describes what it does: Output Device Emulation Protection or ODEP. It not only simulates the operation of the output transistors but it also compares their operation to their known SOA. If ODEP sees that more power is about to be asked of the output devices than they are capable of delivering under the present conditions, ODEP immediately limits the drive level until it falls within the SOA. Limiting is proportional and kept to an absolute minimum—only what is required to prevent the possibility of output transistor damage.

This level of protection enables Crown to increase output transistor utilization while greatly increasing amplifier reliability.

Finally, this onboard intelligence is monitored in two ways. First, the front panel ODEP indicators show whether the amplifier is functioning correctly or if ODEP is limiting the drive level. Second, ODEP data is fed to the PIP connector at the back of the amplifier so advanced PIP modules like the IQ-PIP-SMT can use it to make decisions and control the amplifier.

With ODEP you get the maximum power with the maximum protection—the show goes on!

### 4.3.2 Standby Mode

An important part of a Macro-Tech amplifier's protection systems is standby mode. Standby protects the amplifier during potentially catastrophic conditions. It temporarily removes power from the high-voltage supplies to protect the amplifier and its loads. Standby mode can be identified using the indicator table in Figure 4.2.

When you turn on the Enable switch, standby mode is activated to provide turn-on protection. This power-up delay lets other system components settle before any signals are amplified, and it provides some "randomness" to the power-up sequence of multiple units which reduces the system's current demand during start-up.

If dangerous subsonic frequencies or direct current (DC) is detected in the amplifier's output, the unit will activate its DC/low-frequency protection circuitry and put the affected channels in standby. This protects the loads and prevents oscillations. The unit resumes normal operation as soon as the amplifier no longer detects dangerous low-frequency or DC output. Although it is extremely unlikely that you will ever activate the amplifier's DC/low-frequency protection system, improper source materials such as subsonic square waves or input overloads that result in excessively clipped input signals can activate this system.

The amplifier's fault protection system will put an amplifier channel into standby mode in rare situations where heavy common-mode current is detected in a channel's output. The amplifier should never output heavy common-mode current unless its circuitry is damaged in some way, and putting the channel in standby mode helps to prevent further damage.

The amplifier's transformer thermal protection circuitry is activated where the unit's transformer temperature rises to unsafe levels. Under these abnormal conditions, the amplifier will put both channels into standby mode. In addition, the cooling fan will run at full speed. The amplifier will return to normal operation after the transformer cools to a safe temperature. (For more information on transformer thermal protection, refer to the section that follows.)

### 4.3.3 Transformer Thermal Protection

All Macro-Tech amplifiers have transformer thermal protection which protects the power supplies from damage under rare conditions where the transformer temperature rises too high. A thermal switch embedded in each channel's power transformer removes power to that channel's high-voltage power supply if it detects excessive heat. The switch automatically resets itself as soon as the transformer cools to a safe temperature.

If your amplifier is operated within rated conditions, it is unlikely that you will ever see it activate transformer thermal protection. One reason is that ODEP keeps the amplifier working under severe conditions. Even so, higher than rated output levels, excessively low-impedance loads and unreasonably high input signals can generate excessive heat in the output devices. This can overheat the transformer and activate its protection system.

Macro-Tech amplifiers are designed to keep working under conditions where other amplifiers would fail. But even when the limits of a Macro-Tech are exceeded, it protects itself—and your investment—from damage.

### 4.3.4 Circuit Breaker

A circuit breaker is provided to prevent excessive current draw by the high-voltage power supplies. A reset button for the circuit breaker is provided on the back panel. The rating of the circuit breaker for each amplifier model and each AC mains voltage is provided with the specifications in Section 6. When operating with rated loads and output levels, this breaker should only trip in the incredibly rare instance of a catastrophic amplifier failure. Other protection systems such as ODEP keep the amplifier safe and operational under most other severe conditions. The breaker can also trip in situa-

tions where extremely low-impedance loads and sustained high output levels result in current draw that exceeds the breaker's rating. Again, this should only be possible when operating *outside rated conditions* or when an input signal is clipped severely.

## 4.4 Controls

The **Enable switch** is located on the front panel so you can easily turn the amplifier on and off. If you ever need to make wiring or other installation changes, don't forget to disconnect the power cord. The six steps listed next should be followed whenever you turn on the amplifier.

1. Turn down the level of your audio source. For example, set your master mixer's volume to –∞.
2. Turn down the Level controls of the amplifier (if they are not already down).
3. Turn on the Enable switch. The Enable indicator beside the switch should glow. During the four second mute delay which immediately follows, the Signal/IOC indicators may flash unpredictably and the ODEP LEDs will stay off. After the mute delay, the ODEP indicators should come on with full brilliance and the Signal/IOC indicators should function normally (remain off if no signal is present; flash if a signal is present). Remember, the Channel 2 Signal/IOC indicator remains on if the amplifier is in Parallel-Mono mode.
4. After the mute delay, turn up the level of your audio source to the maximum desired level.
5. Turn up the Level controls of the amplifier until the maximum desired sound level is achieved.
6. Turn down the level of your audio source to its normal range.

For ease of use, the **Level controls** are located on the front panel. Each control has 31 detents for accuracy. To secure these controls, the Level Control Security Kit is available (see Section 8.2). *Note: In Bridge-Mono or Parallel-Mono mode, turn down the Channel 2 Level control and only use the Channel 1 control.*

The **Input Sensitivity Switch** is located inside the back of the amplifier (Figure 4.3). It is set at the factory to 0.775 volts for rated output into 8 ohms. It can also be switched to a sensitivity of 1.4 volts, or a fixed voltage gain of 26 dB (4.8 volts for rated output).

How to change the input sensitivity:

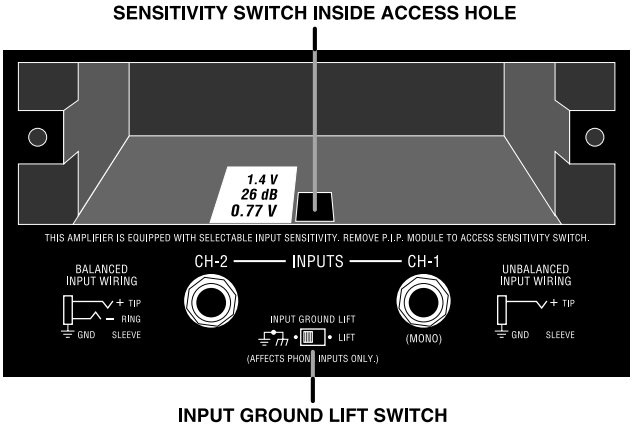



*Fig. 4.3 Input Sensitivity and Ground Lift Switches*

1. Turn off the amplifier and disconnect its power cord from the AC mains power receptacle.
2. Remove the PIP module (two screws).
3. Locate the sensitivity switch access hole inside the chassis opening as shown in Figure 4.3. It is located just above the phone jack inputs.

   Note: The Sensitivity switch will not be visible because it is mounted below the hole. Use your little finger to reach it.
4. Set the switch to the desired position noted on the access hole label. The position toward the front panel sets the sensitivity to 1.4 volts for rated output, the middle position provides a voltage gain of 26 dB, and the position toward the back panel sets the sensitivity to 0.775 volts for rated output.
5. Replace the PIP module and restore the power.

The **Input Ground Lift switch** is located on the rear panel (Figure 4.3) and can provide isolation between the input signal ground and the AC ground. It affects only the phone jack inputs and has no affect on the input connectors on the PIP module. Sliding the switch to the left isolates or "lifts" the grounds by placing an impedance between the sleeve of each phone jack and the circuit ground.

When a PIP module is plugged into the amplifier, only the noninverted and inverted signal lines are connected in parallel with the corresponding lines of the input phone jacks. The signal grounds are not paralleled. For example, XLR pins 2 and 3 are connected in parallel with the tip and ring of the corresponding phone jack. However, pin 1 of the XLR is not connected in parallel with the sleeve of the phone jack.

* Factory setting for international models is 1.4 V.

The **Circuit Breaker Reset Buttons** (PUSH TO RESET) are located on the back panel to protect the power supplies against overload. If a circuit breaker trips, the Signal/IOC indicator of the affected channel turns on (the Enable indicator remains illuminated).

## 4.5 Filter Cleaning

Dust filters are provided on the air intakes to the cooling system (Figure 2.1). If these filters become clogged, the unit will not cool as efficiently as it should and may produce lower-than-normal output levels due to high heat diffuser temperature and activation of the ODEP circuitry.

Dust filters are not 100% efficient—depending on the local environment, the internal heat sinks of the amplifier will benefit from periodic cleaning by a qualified technician. Internal cleaning information is available from our Technical Support Group.

# 5 Technical Information

## 5.1 Overview

Your Macro-Tech VZ amplifier incorporates several new technological advancements including low-stress output stages, real-time computer simulation of output transistor conditions, advanced thermal management, a modular system for signal input and processing, and the articulated VZ power supplies.

Custom protection circuitry limits temperature and current to safe levels while making the amplifier highly reliable and tolerant of faults. Unlike many lesser amplifiers, it can operate at its voltage and current limits without self-destructing.

Real-time computer simulation is used to create an analogue of the junction temperature of the output transistors (hereafter referred to as the "output devices"). Current is limited only when the device temperature becomes excessive—and just by the minimum amount necessary. This patented approach is called ODEP or Output Device Emulation Protection. It maximizes the available output power and eliminates overheating, the major cause of output device failure.

The amplifier is protected from all common hazards that plague high-power amplifiers including shorted, open or mismatched loads; overloaded power supplies, excessive temperature, chain-destruction phenomena, input overload damage and high frequency blowups. The unit protects loudspeakers from DC in the input signal, DC in the output, turn-on and turn-off transients, and it detects and prevents unwanted DC in the output. The amplifier is also protected from internal faults.

The patented four-quadrant topology used in the grounded output stages is called the Grounded Bridge. The Grounded Bridge topology takes full advantage of the power supplies delivering peak-to-peak voltages to the load that are twice the voltage seen by the output devices and twice the voltage generated by the power supplies.

The Grounded Bridge topology is ground-referenced. Because the required current exceeds the limits of presently available components, composite output devices are constructed to function as gigantic NPN and PNP devices. Each output stage has two composite NPN and two composite PNP devices.

The devices connected to the load are referred to as "high-side NPN and PNP" and the devices connected to ground are referred to as "low-side NPN and PNP."

Positive current is delivered to the load by increasing conductance simultaneously in the high-side NPN and low-side PNP stage, while decreasing conductance of the high-side PNP and low-side NPN in synchrony.

The two channels may be used together to double the voltage (Bridge-Mono) or the current (Parallel-Mono) presented to the load. This feature gives the user flexibility in maximizing the power available to the load.

A wide-bandwidth multiloop design is used for state-of-the-art compensation. This produces ideal behavior, and results in ultra-low distortion values.

Aluminum extrusions have been widely used for heat sinks in power amplifiers due to their low cost and reasonable performance. However, measured on a watts per pound or watts per volume basis, the extrusion technology doesn't perform nearly as well as the heat sink technology developed for Macro-Tech power amplifiers.

Our heat sinks are fabricated from custom convoluted fin stock that provides an extremely high ratio of area to volume, or area to weight. All power devices are mounted directly to massive heat spreaders that are electrically alive. Electrifying the heat spreaders improves thermal performance by eliminating the insulating interface underneath the power devices. The chassis itself is used as part of the thermal circuit, and this maximizes utilization of the available resources.

## 5.2 VZ Power

VZ means Variable Impedance. It is the name of Crown's patented articulated power supply technology. This technology is what makes it possible to pack such tremendous power into Crown's Macro-Tech 3600VZ and 5000VZ amplifiers.

### 5.2.1 Background

A power supply must be large enough to handle the maximum voltage and current necessary for the amplifier to drive its rated power into a specified load. In the process of fulfilling this requirement, conventional power supply designs produce lots of heat, are heavy, and take up precious real estate. And it is no secret that heat is one of a power amplifiers worst enemies. Consider the circuit in Figure 5.1.

According to Ohm's Law, the bigger the power supply, the more heat the power transistors must dissipate.

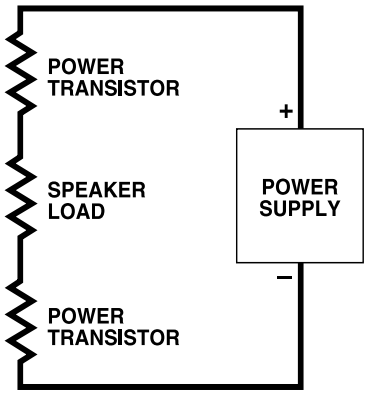



*Fig. 5.1 A Typical Power Supply*

Also, the lower the resistance of the power transistors, the more voltage you can deliver to the load. But when you lower the resistance of the transistors, you increase the current passing through them, and again increase the amount of heat they must dissipate.

### 5.2.2 The VZ Supply

An articulated power supply like VZ avoids much of this problem by reducing the voltage applied to the transistors when less voltage is needed. Reducing the voltage reduces the heat, so the amplifier runs cooler and more power can be packed in safely.

The VZ supply is divided into segments to better match the voltage and current requirements of the power transistors. Remember that audio signals like music are complex waveforms.

*Fig. 5.2 Music Waveforms Are Complex*

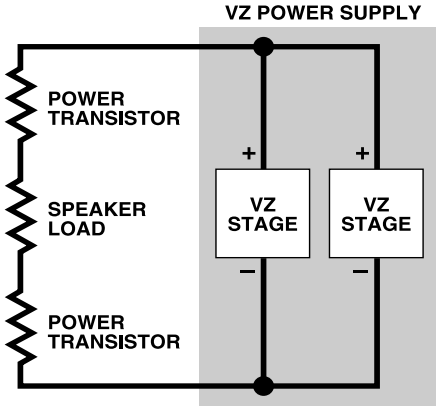



*Fig. 5.3 VZ Supply in Parallel Mode*

For music, the average level is always much less than the peak level. This means a power supply does not need to produce full voltage all the time.

The VZ supply is divided into two parts. When the voltage requirements are not high, it operates in a parallel mode to produce less voltage and more current.

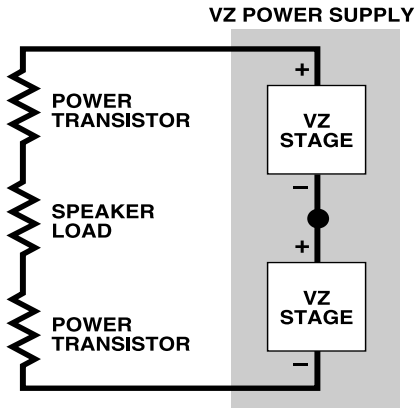



*Fig. 5.4 VZ Supply in Series Mode*

The power transistors stay cooler and are not forced to needlessly dissipate heat. This is the normal operating mode of the VZ power supply.

When the voltage requirements are high, VZ supplies switch to a *series mode* which produces higher voltage and less current. The amplified output signal never misses a beat and gets full voltage when it needs it—not when it doesn't need it.

Sensing circuitry watches the voltage of the signal to determine when to switch VZ modes. The switching circuitry is designed to prevent audible switching distortion to yield the highest possible dynamic transfer function—you hear only the music and not the amplifier. You get not only the maximum power with the maximum safety, but you also get the best power matching to your load.

## 5.3 Circuit Theory

Each channel is powered by its own power transformer, T100 or T200. Both channels share TF-1, a low voltage transformer. The secondary outputs of each transformer are full-wave rectified by heavy duty bridge rectifiers and are filtered by large computer grade capacitors. A thermal switch embedded in each transformer protects them from overheating.

The low voltage transformer TF-1 uses a separate fan motor winding. The TF-1 output is rectified by diodes D1-4 delivering an unregulated 24 volts. Monolithic regulators U1-2 provide a regulated ±15 volts.

### 5.3.1 Stereo Operation

For simplicity, the discussion of stereo operation will refer to one channel only. Mono operation will be discussed later.

See the block diagram in Figure 5.5.

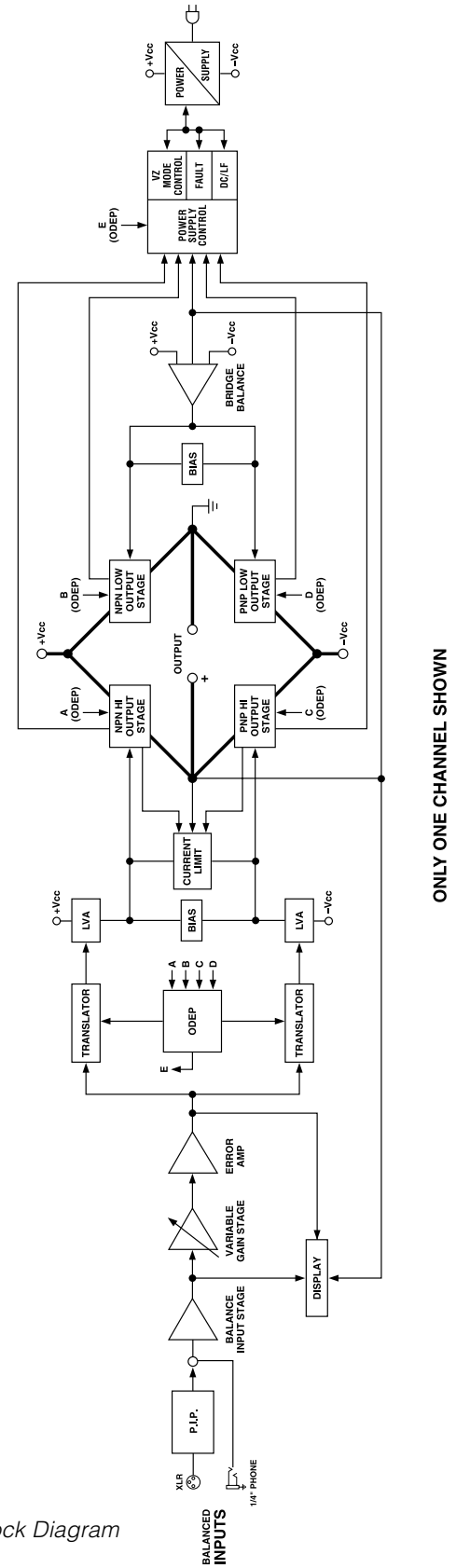



*Fig. 5.5 Circuit Block Diagram*

The input signal at the phone jack passes directly into the balanced gain stage (U104-C,D). Use of a PIP module for input signal causes the input signal to pass through the PIP and then to the balanced gain stage.

The balanced gain stage (U104-C,D) causes balanced-to-single-ended conversion to take place using a difference amplifier. From there, gain can be controlled with a potentiometer. The error amp (U104-A) amplifies the difference between the output signal and the input signal from the gain pot, and drives the voltage translator stage.

The voltage translator stage channels the signal to the Last Voltage Amplifiers (LVAs), depending on the signal polarity, from the error amp U104-A. The +LVA (Q105,Q125) and the –LVA (Q110,Q126), with their push-pull effect through the bias servo Q318, drive the fully complementary output stage.

The bias servo Q318 is thermally coupled to the heat sink, and sets the quiescent bias current in the output stage to lower the distortion in the crossover region of the output signal. D301, D302, D303, and D304 are used to remove the charge on the unused portion of the output stage, depending on the polarity of the output signal.

With the voltage swing provided by the LVAs, the signal then gains current amplification through the Darlington emitter-follower output stage.

The bridge-balanced circuit (U104-B) receives a signal from the output of the amplifier, and differences it with the signal at the Vcc supply. The bridge-balanced circuit then develops a voltage to drive the bridge-balanced output stage. This results in the Vcc supply having exactly one half of the output voltage added to their quiescent voltage. D309, D310, D311 and a trimmer resistor set the quiescent current point for the bridge-balanced output stage.

The protection mechanisms that affect the signal path are implemented to protect the amplifier under real-world conditions. These conditions are high instantaneous current, excessive temperature, and operation of the output devices outside safe conditions.

Q107 and Q108 act as a conventional current limiter, sensing current in the output stage. The allowable current level is also adjusted as a function of voltage. When current at any one instant exceeds the design criteria, the limiters remove the drive from the LVAs, thus limiting current in the output stage to a safe level.

To further protect the output stages, a specially developed ODEP (Output Device Emulation Protection) circuit is used. It produces an analog output proportional to the always-changing safe operating area of the output transistors. This output controls the translator stage by removing any drive that exceeds the safe operating area of the output devices.

Thermal sensor S100 gives the ODEP circuits vital information on the operating temperature of the heatsink on which the output devices are mounted.

Should the amplifier fail in such a way that would cause DC across the output lead, the DC protection circuit senses this on the negative feedback loop and shuts down the power supply until the DC is removed.

### 5.3.2 Bridge-Mono Operation

By setting the back panel Stereo/Mono switch to Bridge-Mono, the user can convert the Macro-Tech into a Bridge-Mono amplifier. With a signal applied to the Channel 1 input and the load between the red binding posts on the back panel, a double voltage output occurs.

The Channel 1 output feeds the Channel 2 error amp U204-A. Since there is a net inversion, Channel 2 output is out of polarity with Channel 1. This produces twice as much voltage across the load. Each of the channel's protection mechanisms work independently if a fault occurs.

### 5.3.3 Parallel-Mono Operation

With the Stereo/Mono switch set to Parallel-Mono, the output of Channel 2 is paralleled with that of Channel 1. A suitable high-current-handling jumper must be connected across the red binding posts to gain the benefits of this mode of operation.

The signal path for Channel 1 is the same as previously discussed, except that Channel 1 also drives the output stage of Channel 2. The balanced input, error amp, translators and LVAs of Channel 2 are disconnected and no longer control the Channel 2 output stage. The Channel 2 output stage and protection mechanisms are also coupled through S1 and function as one.

In Parallel-Mono mode, twice the current of one channel alone can be obtained. Since the ODEP circuit of Channel 2 is coupled through S1, this gives added protection if a fault occurs in the Channel 2 output stage. The ODEP circuit of Channel 2 will limit the output of both output stages by removing the drive from the Channel 1 translator stages.

# 6 Specifications

These specifications apply to 120 VAC units in stereo mode with 8 ohm loads and an input sensitivity of 26 dB unless otherwise specified.

**120 VAC, 60 Hz Units:** These units are equipped with transformers rated for 120 VAC, 60 Hz power.

**International Units:** These units are equipped with transformers for either 100 VAC, 50/60 Hz, or 230 VAC, 50/60 Hz power.

## Performance

**Frequency Response:** ±0.1 dB from 20 Hz to 20 kHz at 1 watt. See Figure 6.3.

**Phase Response:** ±10° from 10 Hz to 20 kHz at 1 watt. See Figure 6.6.

**Signal-to-Noise Ratio:** Greater than 105 dB below rated output (20 Hz to 20 kHz, A-weighted); 100 dB below rated output (20 Hz to 20 kHz, no weighting).

**Harmonic Distortion (THD):** At rated output, less than 0.05% from 20 Hz to 1 kHz increasing linearly to less than 0.1% at 20 kHz.

**IM Distortion (IMD):** Less than 0.05% from 368 milliwatts to full rated output.

**Damping Factor:** Greater than 1,000 from 10 Hz to 400 Hz. See Figure 6.4.

**Crosstalk:** See Figure 6.7.

**Slew Rate:** Greater than 30 volts per microsecond.

**Voltage Gain:** (At maximum output) 20:1 ±6% or 26 dB ±0.5 dB at +26 dB sensitivity, and 124.6:1 ±6 % or 41.9 dB ±0.5 dB at 0.775 volt sensitivity.

## Power

**Output Power:**

*Note: Maximum average watts per channel (unless in Mono mode) at 1 kHz with 0.1% or less THD.*

***120 VAC, 60 Hz Units:***

*Stereo mode with both channels driven:*

1800 watts into 2 ohms.
1565 watts into 4 ohms.
1120 watts into 8 ohms.

*Bridge-Mono mode:*

3505 watts into 4 ohms.
3140 watts into 8 ohms.

*Parallel-Mono mode:*

3555 watts into 1 ohm.
3190 watts into 2 ohms.

***100 VAC International Units:***

*Stereo mode with both channels driven:*

1460 watts into 2 ohms.
1300 watts into 4 ohms.
980 watts into 8 ohms.

*Bridge-Mono mode:*

2835 watts into 4 ohms.
2625 watts into 8 ohms.

*Parallel-Mono Mode*

2820 watts into 1 ohm.
2585 watts into 2 ohms.

***120 VAC International Units:***

*Stereo mode with both channels driven:*

1490 watts into 2 ohms.
1300 watts into 4 ohms.
985 watts into 8 ohms.

*Bridge-Mono mode:*

2980 watts into 4 ohms.
2600 watts into 8 ohms.

*Parallel-Mono Mode*

2980 watts into 1 ohm.
2600 watts into 2 ohms.

***230 VAC International Units:***

*Stereo mode with both channels driven:*

1520 watts into 2 ohms.
1325 watts into 4 ohms.
965 watts into 8 ohms.

*Bridge-Mono mode:*

2800 watts into 4 ohms.
2515 watts into 8 ohms.

*Parallel-Mono Mode*

2910 watts into 1 ohm.
2565 watts into 2 ohms.

**Load Impedance:** Rated for 16, 8, 4, and 2 ohm use only. Safe with all types of loads, even reactive ones.

**AC Power Requirements:** 100 VAC, 50/60 Hz; 120 VAC, 50/60 Hz; and 230 VAC, 50/60 Hz units are available. 230 VAC, 50/60 Hz units can be used with 220 and 240 VAC. All versions draw 90 watts or less at idle. 100 and 120 VAC units can draw up to 30 amps of current; 230 VAC units can draw up to 15 amps. Refer to the back panel for your unit's specifications. Refer to Section 7 for more details.

*It is extremely important to provide sufficient AC power to the amplifier. Power amplifiers cannot create energy—they must have the proper voltage and current to deliver the clean rated power you expect.*

## Controls

**Enable:** A front panel push button used to turn the amplifier on and off.

**Level:** A 31-position detented rotary attenuator for each channel located on the front panel used to control the output level.

**Stereo/Mono:** A three-position back panel switch used to select Stereo, Bridge-Mono or Parallel-Mono operation.

**Sensitivity:** A three-position switch located inside the *PIP* compartment used to select one of three input sensitivities for both channels: 0.775 volts or 1.4 volts for standard 1 kHz power or a voltage gain of 26 dB.

**Input Ground Lift:** A two position back panel switch used to isolate the phone jack signal grounds from the chassis (AC) ground.

**Reset:** A back panel button for each channel used to reset the corresponding power supply. 100 and 120 VAC units have 15 amp circuit breakers. 230 VAC units have 7.5 amp circuit breakers.

## Indicators

**Enable:** This amber indicator is on when the amplifier is switched on to show that the low voltage power supply is operating.

**Signal / IOC*:*** Two green indicators flash with medium intensity in sync with the amplifier's outputs to show signal presence. In the unlikely event the output waveform differs from that of the input by 0.05% or more, they flash brightly to indicate distortion. As sensitive distortion indicators they provide proof of performance. *Note: It is normal for the Channel 2 IOC indicator to remain on in Parallel-Mono mode.*

**ODEP*:*** Each channel has an amber front panel indicator that shows thermal-dynamic energy reserve. Normally, each ODEP indicator is lit to show available reserve energy. The indicator will dim proportionally as the energy reserve for its channel decreases. In the rare event that a channel has no reserve, its indicator will turn off and the ODEP circuitry will limit the channel's output drive (see Section 4.2).

## Input/Output

**Input Connector:** Balanced ¼-inch phone jacks on chassis and internal *PIP* connector. (Balanced 3-pin XLR connectors are provided on the P.I.P.-FX which is a standard feature.)

**Input Impedance:** Nominally 20 k ohms, balanced. Nominally 10 K ohms, unbalanced.

**Input Sensitivity:** Switchable between 0.775 V (unbalanced) for rated output or a fixed voltage gain of 26 dB. (See subsection 4.4 for more information.)

**Output Connector:** Color-coded dual binding posts (banana jacks).

**Output Impedance:** Less than 10 milliohms in series with less than 2 microhenries. See Figure 6.5.

**DC Output Offset:** (Shorted input) ±10 millivolts.

## Output Signal

**Stereo:** Unbalanced, two-channel.

**Bridge-Mono:** Balanced, single-channel. Channel 1 controls are active; Channel 2 controls are inactive and not removed from operation.

**Parallel-Mono:** Unbalanced, single-channel. Channel 1 controls are active; Channel 2 controls are inactive but not removed from operation.

## Protection

Macro-Tech amplifiers are protected against shorted, open or mismatched loads; overloaded power supplies; excessive temperature, chain destruction phenomena, input overload damage and high-frequency blow-ups. They also protect loudspeakers from input/output DC and turn-on/turn-off transients.

If unreasonable operating conditions occur, the patented ODEP circuitry proportionally limits the drive level to protect the output devices, particularly in the case of elevated temperature. Transformer overheating results in a temporary shutdown of the offending channel. When it has cooled to a safe temperature, the transformer automatically resets itself. Controlled slew rate voltage amplifiers protect against RF burnouts, and input overload protection is provided by current-limiting resistance at the input.

**Turn On:** The four second turn-on delay prevents dangerous turn-on transients. Turn-on occurs at zero crossing of the AC waveform, so power sequencers are rarely needed with multiple units. *Note: The turn-on delay time may be changed. Contact Crown's Technical Support Group for details.*

**Circuit Breaker:** Circuit breaker current ratings vary based on the AC operating power.

## Construction

Durable black powder coated steel chassis and aluminum front panel with Lexan overlay; specially designed "flow-through" ventilation from front to side panels.

**Cooling:** Forced-air with custom heat diffusers and patented circuitry to promote uniform dissipation.

**Dimensions:** 19 inch (48.3 cm) standard rack mount (EIA Std. RS-310-B), 3.5 inch (8.9 cm) height, 16 inch (40.6 cm) depth behind mounting surface and 2.5 inches (6.4 cm) in front of mounting surface.

**Approximate Weight:** Center of gravity is 6 inches (15.2 cm) behind the front mounting surface.

***120 VAC, 60 Hz Units:***

Net weight 55 lbs, 1.5 ounces (25.0 kg); shipping weight 63 lbs, 10 ounces (28.9 kg).

***100 VAC International Units:***

Net weight 54 lbs, 5 ounces (24.7 kg); shipping weight 63 lbs, 0.5 ounces (28.6 kg).

***120 VAC International Units:***

Net weight 55 lbs, 1.5 ounces (25.0 kg); shipping weight 63 lbs, 10 ounces (28.9 kg).

***230 VAC International Units:***

Net weight 53 lbs, 6 ounces (24.2 kg); shipping weight 61 lbs, 15 ounces (28.1 kg).

***Crown specifications are guaranteed for three years.***

In an effort to provide you with as much information as possible about the high power-producing capabilities of your amplifier, we have created the following power matrices.

## Minimum Guaranteed Power Specifications

Crown's minimum power specifications represent the absolute smallest amount of output power you can expect from your amplifier when it is driven to full output under the given conditions. Some spaces in each matrix may be left blank because the same guarantee is not provided for those conditions—however, your amplifier will perform well under all conditions listed in each matrix.

When measuring power, 0.1% THD appears to be the industry standard for distortion. Two of the maximum average power specifications shown in each minimum power matrix are measured at 0.1% THD so you can easily compare Crown specifications to those of other manufacturers. But this high level of distortion actually allows for some clipping which is undesirable. Because of this, a maximum average power specification at 0.05% THD is included in each minimum power matrix which represents non-clipped conditions. Although most manufacturers do not give you power specifications at 0.05% THD, we encourage them to provide these specifications so you will have a more realistic representation of the way amplifiers should be used in the real world—without a clipped output signal.

Many manufacturers publish power specs with a tolerance of ±1 dB or worse. This means their amplifier can deviate more than 20% in output! A 100 watt amplifier would meet their specification if it only produced 79.4 watts. Other manufacturers qualify their specs by saying they are "typical," "subject to manufacturing tolerances," "single channel driven" or that they are specified with "fuses bypassed." Each of these statements effectively removes any performance guarantee. In fact, some manufacturers use these tactics to generate large power numbers, and they don't even print a disclaimer. We take a different approach at Crown—our amplifiers are *guaranteed* to meet or exceed their specifications for three years. Further, because our published specs are set below our "in-house" measurements, you can expect *every* Crown amplifier to *exceed* its published minimum power specs. We believe you should get what you pay for.

**Macro-Tech 3600VZ – Minimum Power (Watts)**

| AC Mains | Stereo/Mono Mode | Load (Ohms) | Maximum Average 0.1% THD (See note 1) 1 kHz | Maximum Average 0.1% THD (See note 2) 20Hz-20kHz | Maximum Average 0.05% THD (See note 3) 1 kHz | FTC Continuous Average 0.1% THD (See note 4) 1 kHz | FTC Continuous Average 0.1% THD (See note 4) 20Hz-20kHz |
|---|---|---|---|---|---|---|---|
| 120 VAC, 60 Hz Units | Stereo (both channels driven) | 2 | 1800 | | 1785 | | |
| | | 4 | 1565 | | 1555 | | |
| | | 8 | 1120 | 1035 | 1110 | 1060 | 885 |
| | Bridge-Mono (balanced output) | 4 | 3505 | | 3490 | | |
| | | 8 | 3140 | | 3110 | | |
| | | 16 | 2210 | | 2190 | 2115 | <680 |
| | Parallel-Mono | 1 | 3555 | | 3530 | | |
| | | 2 | 3190 | | 3155 | | |
| | | 4 | 2235 | | 2225 | 2140 | |
| 100 VAC Transformer | Stereo (both channels driven) | 2 | 1460 | | 1360 | | |
| | | 4 | 1300 | | 1290 | | |
| | | 8 | 980 | 940 | 970 | 895 | 850 |
| | Bridge-Mono (balanced output) | 4 | 2835 | | 2825 | | |
| | | 8 | 2625 | | 2600 | | |
| | | 16 | 1950 | | 1940 | 1780 | <680 |
| | Parallel-Mono | 1 | 2820 | | 2810 | | |
| | | 2 | 2585 | | 2550 | | |
| | | 4 | 1940 | | 1925 | 1785 | |
| 230 VAC Transformer | Stereo (both channels driven) | 2 | 1520 | | 1495 | | |
| | | 4 | 1325 | | 1300 | | |
| | | 8 | 965 | 955 | 930 | 870 | 275 |
| | Bridge-Mono (balanced output) | 4 | 2800 | | 2740 | | |
| | | 8 | 2515 | | 2445 | | |
| | | 16 | 1900 | 1765 | 1855 | 1735 | |
| | Parallel-Mono | 1 | 2910 | | 2840 | | |
| | | 2 | 2565 | | 2520 | | |
| | | 4 | 1935 | | 1915 | 1750 | |

*Figure 6.1 Minimum Power Matrix*

### Minimum Power Notes:

All minimum power specifications are based on 0.5% regulated AC mains with THD of less than 1.0% and an ambient room temperature of 70° F (21° C). Standard EIA power (RS-490) is not shown here because it is identical to FTC Continuous Average Power.

1. A 1 kHz sine wave is presented to the amplifier and the output monitored for nonlinear distortion. The level is increased until THD reaches 0.1%. At this point, average power per channel is reported.
2. A sine wave is presented to the amplifier over the range from 20 Hz to 20 kHz and the output monitored for nonlinear distortion. The level at each frequency is increased until THD reaches 0.1%. At this point, average power per channel is reported.
3. A 1 kHz sine wave is presented to the amplifier and the output monitored for nonlinear distortion. The level is increased until THD reaches 0.05%. At this point, average power per channel is reported.
4. Continuous power in the context of Federal Trade Commission testing is understood to be a minimum of five minutes of operation. Harmonic distortion is measured as the RMS sum total and given as a percentage of the fundamental output voltage. This applies for all wattages greater than 0.25 watts.

## Maximum Power Specifications

Crown's maximum power specifications represent the largest amount of output power you can expect from your amplifier when it is driven to full output under the given conditions. These specifications can be used to prevent loudspeaker and hearing damage.

The maximum power matrices include specifications for single cycle and 40 millisecond burst sine waves. Burst signals act like large transient peaks that are present in common source signals. Loudspeakers can respond to a single cycle burst, so the single cycle burst specifications should be used to help you protect your loudspeakers. In contrast, a 40 millisecond burst represents the typical response time of the human ear. Your ear will not respond to the entire dynamic change of a burst that lasts less than 40 milliseconds.

The burst power specifications are provided at 0.05% THD which is a practical low distortion condition. Operating the amplifier at levels higher than 0.05% THD can result in output power levels that are higher than those listed in the maximum power matrices.

**Macro-Tech 3600VZ – Maximum Power (Watts)**

| AC Mains | Stereo/Mono Mode | Load (Ohms) | Single Cycle Tone Burst 0.05% Distortion (See note 1) | | | | 40 Millisecond Tone Burst 0.05% Distortion (See note 2) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 20 Hz | 50 Hz | 1 kHz | 7 kHz | 50 Hz | 1 kHz | 7 kHz |
| 120 VAC, 60 Hz Units | Stereo (both channels driven) | 2 | 1915 | 2320 | 2375 | 1610 | 2320 | 2000 | 1610 |
| | | 4 | 1670 | 2230 | 3270 | 3140 | 1860 | 1690 | 1745 |
| | | 8 | 1260 | 1460 | 1830 | 1760 | 1295 | 1175 | 1235 |
| | Bridge-Mono (balanced output) | 4 | 3815 | 4630 | 4670 | 2930 | 4520 | 3920 | 2930 |
| | | 8 | 3315 | 4425 | 6495 | 6140 | 3735 | 3315 | 3355 |
| | | 16 | 2375 | 2915 | 3605 | 3460 | 2565 | 2325 | 2420 |
| | Parallel-Mono | 1 | 3810 | 4240 | 4310 | 2880 | 4240 | 3910 | 2880 |
| | | 2 | 3310 | 4500 | 6480 | 6125 | 3685 | 3345 | 3380 |
| | | 4 | 2475 | 2920 | 3655 | 3485 | 2545 | 2355 | 2425 |
| 100 VAC Transformer | Stereo (both channels driven) | 2 | 1535 | 2175 | 2285 | 1490 | 1930 | 1655 | 1490 |
| | | 4 | 1375 | 2065 | 3220 | 3170 | 1620 | 1495 | 1530 |
| | | 8 | 1110 | 1370 | 1810 | 1770 | 1155 | 1110 | 1155 |
| | Bridge-Mono (balanced output) | 4 | 3060 | 4325 | 4575 | 2715 | 3745 | 3300 | 2715 |
| | | 8 | 2745 | 4055 | 6425 | 6270 | 3310 | 2950 | 3020 |
| | | 16 | 2190 | 2725 | 3625 | 3510 | 2330 | 2215 | 2285 |
| | Parallel-Mono | 1 | 3065 | 4045 | 4245 | 2680 | 3820 | 3300 | 2680 |
| | | 2 | 2760 | 4145 | 6465 | 6260 | 3250 | 2965 | 3035 |
| | | 4 | 2210 | 2755 | 3645 | 3500 | 2325 | 2210 | 2275 |
| 230 VAC Transformer | Stereo (both channels driven) | 2 | 1650 | 2310 | 2365 | 1695 | 2005 | 1665 | 1695 |
| | | 4 | 1450 | 2030 | 3030 | 2890 | 1655 | 1435 | 1485 |
| | | 8 | 1060 | 1330 | 1695 | 1615 | 1160 | 1060 | 1095 |
| | Bridge-Mono (balanced output) | 4 | 3355 | 4570 | 4645 | 2935 | 4040 | 3385 | 2935 |
| | | 8 | 2905 | 4095 | 6050 | 5765 | 3280 | 2870 | 2940 |
| | | 16 | 2115 | 2675 | 3345 | 3215 | 2890 | 2095 | 2160 |
| | Parallel-Mono | 1 | 2860 | 4275 | 4380 | 3240 | 3870 | 2945 | 3030 |
| | | 2 | 2565 | 3685 | 6005 | 5770 | 3185 | 2630 | 2690 |
| | | 4 | 1955 | 2515 | 3390 | 3230 | 2270 | 1975 | 2035 |

*Figure 6.2 Maximum Power Matrix*

**Maximum Power Notes:**

All maximum power specifications are based on 0.5% regulated AC mains with THD of less than 1.0% and an ambient room temperature of 70° F (21° C). Although it is an unusual condition, your amplifier can function well with AC mains voltages up to 10% over the specified line voltage. With overvoltage conditions, your amplifier may be capable of delivering instantaneous power levels up to 20% greater than the specifications in the matrix.

1. A single cycle sine wave is presented to the amplifier and monitored for nonlinear distortion. The average power during the burst is reported. Loudspeakers must be able to withstand this level if they are to be safely used with this amplifier.
2. A 40 millisecond sine wave burst (10 percent duty cycle) is presented to the amplifier and monitored for nonlinear distortion. Average power during the burst is reported. This power level is a measurement of the amplifier's maximum transient power that can be perceived by the human ear.

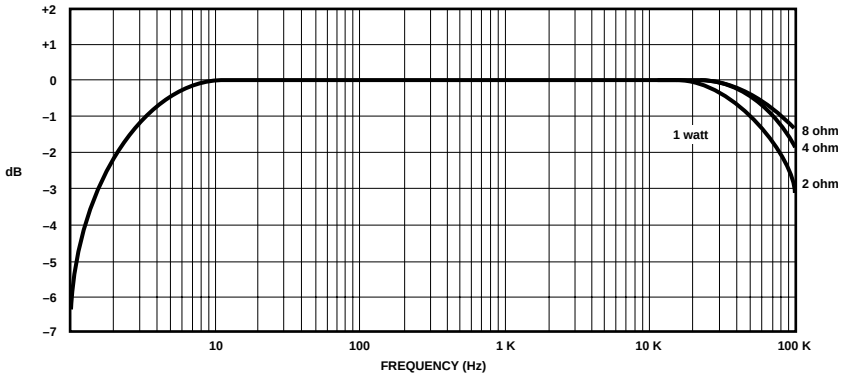



*Fig. 6.3 Typical Frequency Response*

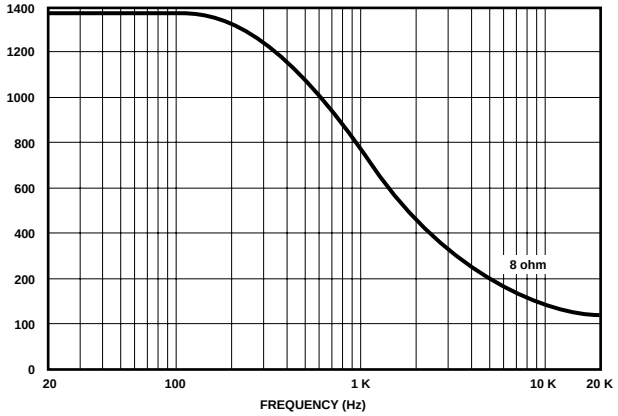



*Fig. 6.4 Typical Damping Factor*

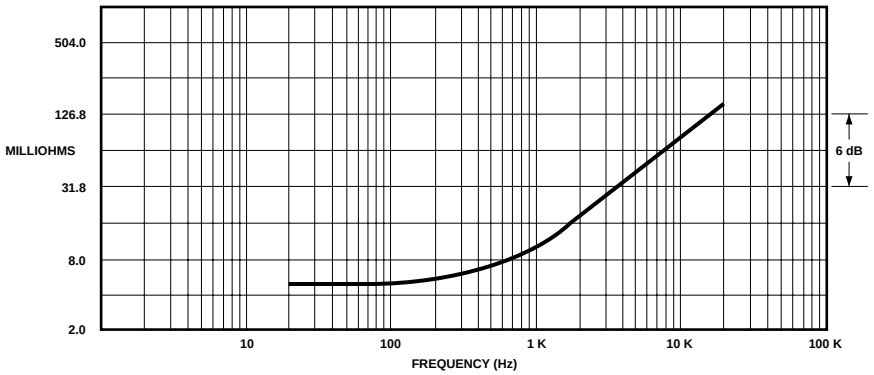



*Fig. 6.5 Typical Output Impedance*

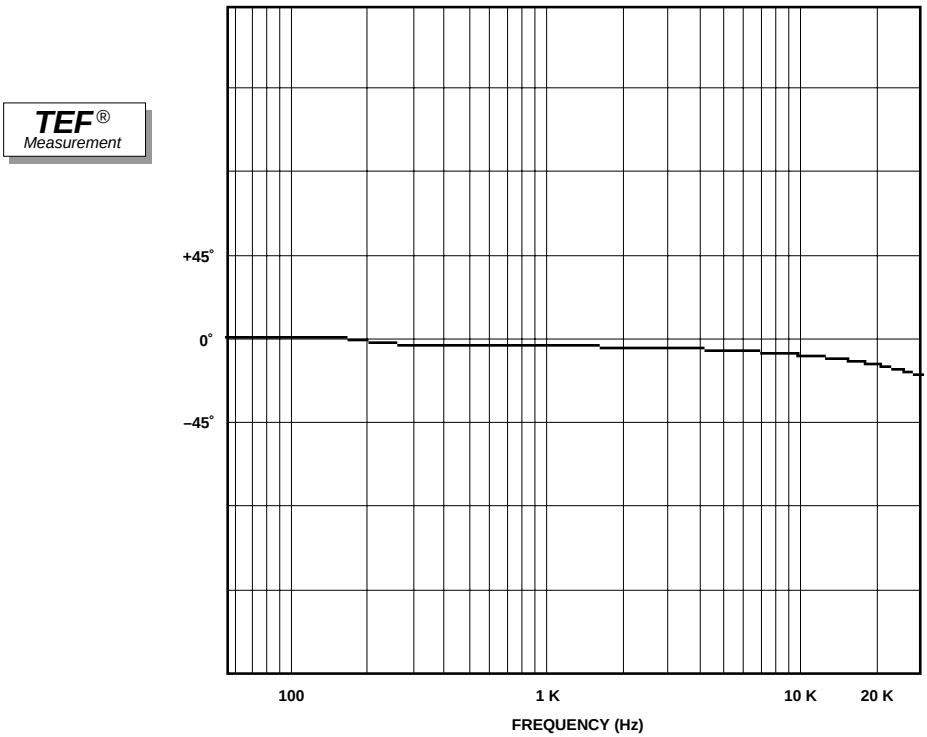



*Fig. 6.6 Typical Phase Response*

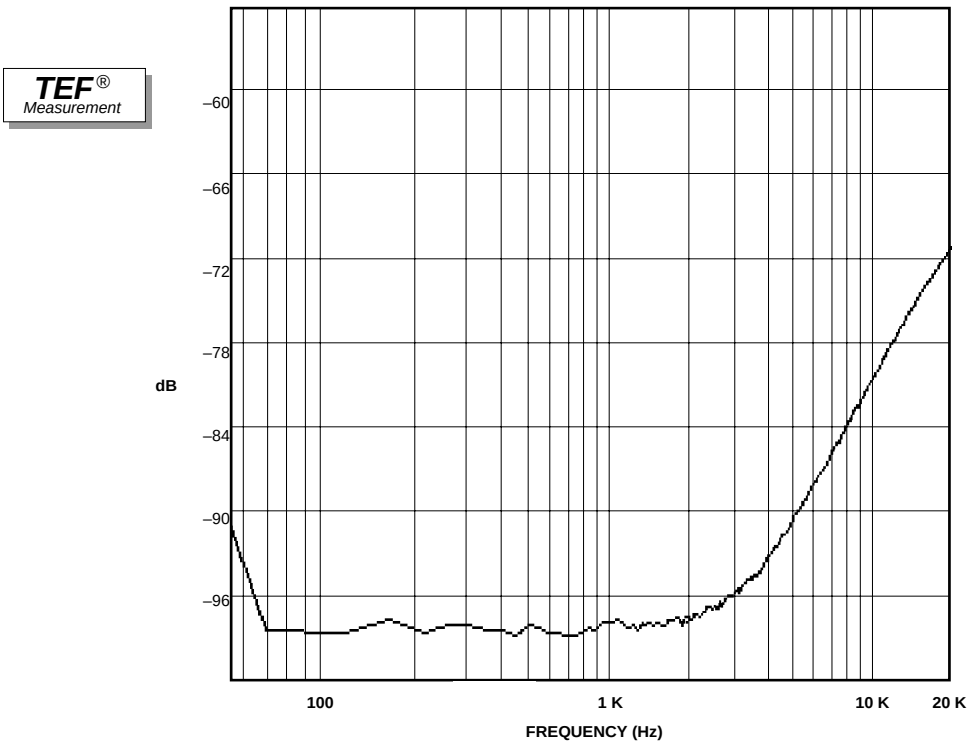



*Fig. 6.7 Typical Crosstalk*

# 7 AC Power Draw and Thermal Dissipation

This section provides detailed information about the amount of power and current drawn from the AC mains by the Macro-Tech 3600VZ, and the amount of heat produced under various conditions. The calculations presented here are intended to provide a very realistic and reliable depiction of the amplifier. The following assumptions were made:

- The amplifier's available channels are loaded, and full, standard 1 kHz power is being delivered.
- The amplifier's efficiency at standard 1 kHz power is estimated to be 73%.
- Quiescent power draw is 90 watts (an almost negligible amount for full-power calculations).
- Quiescent heat dissipation equals 105 btu/hr at 90 watts.
- Duty cycle of pink noise is 50%.
- Duty cycle of highly compressed rock 'n' roll midrange is 40%.
- Duty cycle of rock 'n' roll is 30%.
- Duty cycle of background music is 20%.
- Duty cycle of continuous speech is 10%.
- Duty cycle of infrequent, short-duration paging is 1%.

Here are the equations used to calculate the data presented in Figures 7.1:

$$\text{AC Mains Power Draw (watts)} = \frac{\text{Total output power with all channels driven (watts)} \times \text{Duty Cycle}}{\text{Amplifier Efficiency}} + \text{Quiescent and Fan Power Draw (watts)}$$

The following equation converts power draw in watts to current draw in amperes:

$$\text{Current Draw (amperes)} = \frac{\text{AC Mains Power Draw (watts)}}{\text{AC Mains Voltage} \times \text{Power Factor}}$$

The value used for Power Factor is 0.83. The Power Factor variable is needed to compensate for the difference in phase between the AC mains voltage and current.

The following equation is used to calculate thermal dissipation.

$$\text{Thermal Dissipation (btu/hr)} = \left( \frac{\text{Total output power with all channels driven (watts)} \times \text{Duty Cycle} \times \text{Amplifier Inefficiency}}{\text{Amplifier Efficiency}} + \text{Quiescent and Fan Power Draw (watts)} \right) \times 3.415$$

The value used for Amplifier Inefficiency is 0.27 (1.00–0.73). The factor 3.415 converts watts to btu/hr. Thermal dissipation in btu is divided by the constant 3.968 to get kcal.

If you plan to measure output power under real-world conditions, the following equation may also be helpful:

$$\text{Thermal Dissipation (btu/hr)} = \left( \frac{\text{Total measured output power from all channels (watts)} \times \text{Amplifier Inefficiency}}{\text{Amplifier Efficiency}} + \text{Quiescent and Fan Power Draw (watts)} \right) \times 3.415$$

**Macro-Tech 3600VZ**

| | LOAD | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8 Ohm Stereo / 4 Ohm Parallel-Mono | | | | | 4 Ohm Stereo / 8 Ohm Bridge-Mono / 2 Ohm Parallel-Mono | | | | | 2 Ohm Stereo / 4 Ohm Bridge-Mono / 1 Ohm Parallel-Mono | | | | |
| Duty Cycle | AC Mains Power Draw (Watts) | Current Draw (Amps) | | Thermal Dissipation | | AC Mains Power Draw (Watts) | Current Draw (Amps) | | Thermal Dissipation | | AC Mains Power Draw (Watts) | Current Draw (Amps) | | Thermal Dissipation | |
| | | 100-120 V | 220-240 V | btu/hr | kcal/hr | | 100-120 V | 220-240 V | btu/hr | kcal/hr | | 100-120 V | 220-240 V | btu/hr | kcal/hr |
| 50% | 1,633 | 19.7 | 8.9 | 1,584 | 399 | 2,246 | 27.1 | 12.3 | 2,101 | 529 | 2,569 | 31.0 | 14.1 | 2,374 | 598 |
| 40% | 1,324 | 16.0 | 7.3 | 1,323 | 333 | 1,815 | 21.9 | 9.9 | 1,738 | 438 | 2,073 | 25.0 | 11.4 | 1,956 | 493 |
| 30% | 1,016 | 12.2 | 5.6 | 1,064 | 268 | 1,383 | 16.7 | 7.6 | 1,374 | 346 | 1,578 | 19.0 | 8.6 | 1,538 | 388 |
| 20% | 707 | 8.5 | 3.9 | 803 | 202 | 952 | 11.5 | 5.2 | 1,010 | 254 | 1,082 | 13.0 | 5.9 | 1,119 | 282 |
| 10% | 399 | 4.8 | 2.2 | 543 | 137 | 521 | 6.3 | 2.9 | 646 | 163 | 586 | 7.1 | 3.2 | 701 | 177 |

*Fig. 7.1 Power Draw, Current Draw and Thermal Dissipation at Various Duty Cycles*

# 8 Accessories

## 8.1 PIP Modules

One advantage of Crown PIP compatible amplifiers is the ability to customize them using PIP (Programmable Input Processor) and PIP2 modules. The PIPs shown here may be used in any Crown PIP-compatible amplifier. PIPs carrying the PIP2 logo have been configured with an extended, PIP2-enhanced feature set. These PIPs may also be used in any PIP-compatible amplifier; however, extended features will only be available in PIP2-compatible amplifiers.

This PIP-compatible amplifier is equipped with an edge card connector inside the back panel PIP compartment. The PIP modules install easily:

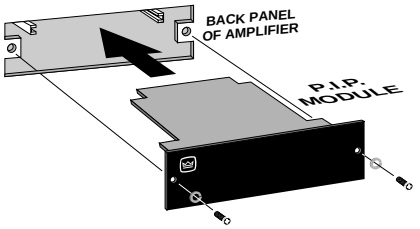
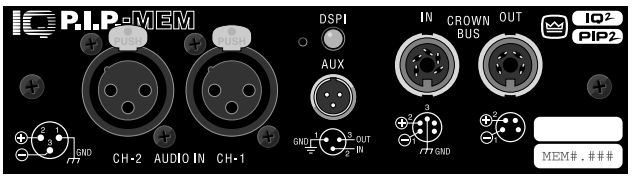



*Fig. 8.1 Installing a PIP Module*

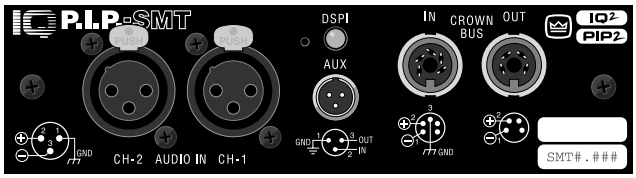
**WARNING: Disconnect power to the amplifier when installing or removing a PIP module.**

For more information on these or other PIPs under development, contact your local dealer or Crown's Technical Support Group.

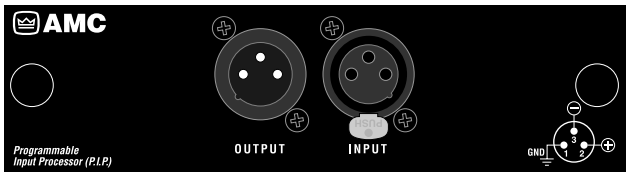
**IQ-P.I.P.-DSP** is an IQ System Programmable Input Processor with DSP (Digital Signal Processing) for PIP-compatible amplifiers. As a component of the IQ System, it connects the amplifier to the Crown Bus so the amplifier can be controlled and monitored. Its DSP capabilities enable it to be programmed with a variety of functions, such as filters and crossovers, signal delay, input compressor and output limiter, and a variety of other useful features similar to those included with the IQ-P.I.P-SMT. Requires an IQ2 interface and a computer for initial setup.



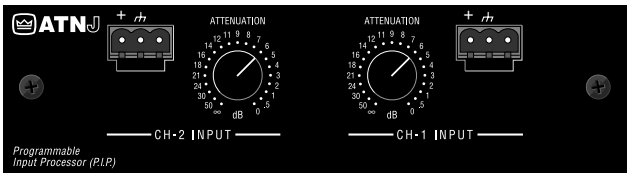

**IQ-P.I.P.-MEM** Integrates Crown PIP-compatible amplifiers into Crown's IQ System. Each channel of each amplifier can be monitored and individually controlled from an inexpensive PC. A total of 15 functions can be either monitored or controlled. Memory backup is also incorporated in case of power failure. Requires an IQ2 interface and a computer for initial setup.



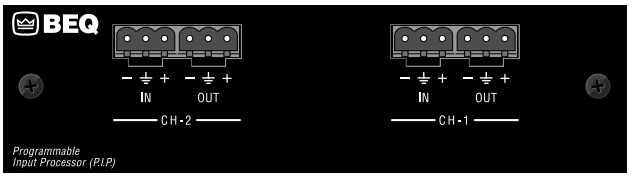

**IQ-P.I.P.-SMT** "Smart Amp" offers impressive new features unavailable elsewhere. The processing speed is substantially enhanced over other designs. A programmable power-supply gate conserves energy by shutting off the amplifier's high-power supplies until an audio signal is present. The user may define error-reporting conditions of the amplifier. There is much greater flexibility and thermal operational protection available, as well as a built-in smooth output limiter to discretely control maximum amplifier output. Requires an IQ2 interface and a computer for initial setup.




**P.I.P.-AMCb** combines many of the features found in the P.I.P.-XOV and P.I.P.-CLP to provide both a variable 4th-order Linkwitz-Riley crossover and an IOC-driven or variable-threshold signal-driven compressor. In addition, variable equalization networks provide for "constant-directivity" horn equalization and filter-assisted B6 vented bass box equalization. Bi-amping and tri-amping capabilities are provided via XLR connectors.

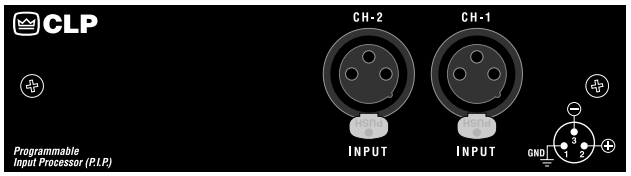



**P.I.P.-ATNJ** includes the features of the P.I.P.-FXT (balanced Jensen® 1:1 isolation transformers) and adds to each channel a 12-dB/octave RFI filter, a variable 18-dB/octave high-pass filter (to reduce bass/subsonic frequencies), and a 6-dB/octave 3-kHz shelving network for "constant-directivity" horn equalization. Special quick-connect barrier blocks are provided for inputs to each channel. Also adds a Jensen® 32-step precision attenuator to each channel.

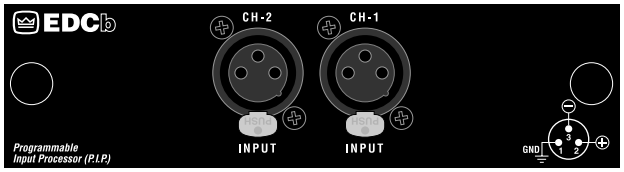



**P.I.P.-BEQC** adds many features of the Bose® Controllers to the input of your amplifier. Each channel includes a custom equalization network for Bose loudspeakers. Also included is a bass-cut (high-pass) filter for each channel. The equalization and bass-cut filters can be bypassed, if desired. Balanced inputs and "daisy-chain" outputs use removable barrier block connectors for quick, solderless connections.

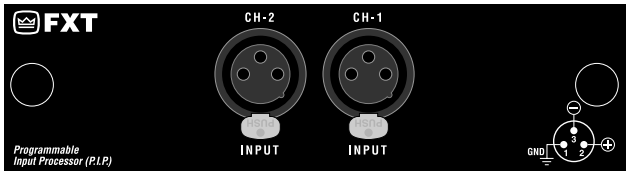
**P.I.P.-BEQX** Same as P.I.P.-BEQC but with XLR connectors.



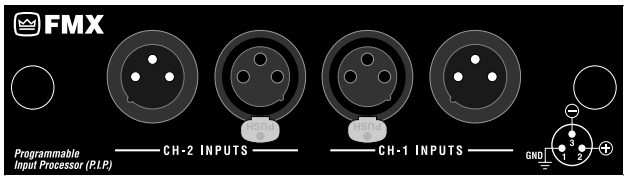

**P.I.P.-CLP** is designed to detect and prevent overload. The same error detecting circuit that is used to signal the IOC indicator is used to activate this error-driven compressor. It is not a typical signal-driven compressor, but a circuit to prevent any overload. It can yield up to 13 dB or additional signal safety margin without noticeable program change.



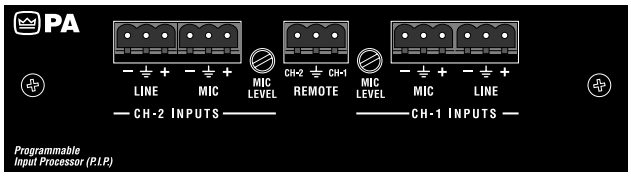

**P.I.P.-EDCb** State-of-the-art programmable error-driven and signal-driven compressor plus a variable high-pass filter for each channel. Fast or slow attach and release times can be set independently for each channel.



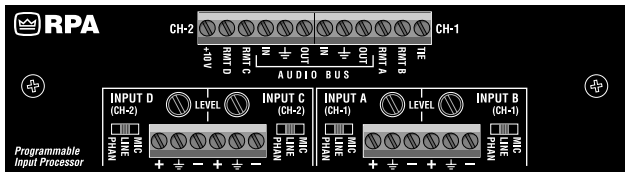

**P.I.P.-FXT** uses balanced 1:1 transformers to isolate the source from the inputs. It comes with balanced female 3-pin XLR connectors.




**P.I.P.-FMX** facilitates "daisy-chaining" several amplifier balanced inputs together. Female to Male 3-pin XLR connectors are used to passively bridge the amplifier inputs.

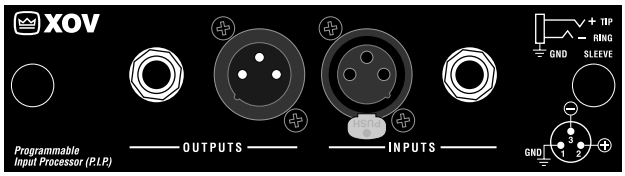



**P.I.P.-PA** permits the unique capability of adding one mic/line input directly to each channel of an amplifier. With phantom power for microphones, this mic/line input may be remotely switched from mic to line priorities.




**P.I.P.-RPA** A phantom-power mixer that has four balanced mic or line inputs with voiceover capability and adjustable "duck" level, 84 dB of attenuation. A 10-volt DC source for remote control capability is provided. The P.I.P.-EXT (Part M44731-4), available from service, allows the P.I.P.-RPA and other PIP cards to be "extended" outside the amplifier for easy set up.

**P.I.P.-RPAT** has the same features as the P.I.P.-RPA but includes four input transformers.




**P.I.P.-XOV** is a versatile, economical mono 12- or 18-dB/octave crossover/filter which offers bi-amping and tri-amping capability.

## 8.2 Level Control Shaft Lock

A security accessory, the shaft lock can be used to secure your amplifier's level controls in situations where the front panel controls are subject to tampering. One is needed for each channel.They can be ordered through the Crown Service/Parts Department. For more information, contact the Crown Service Department.

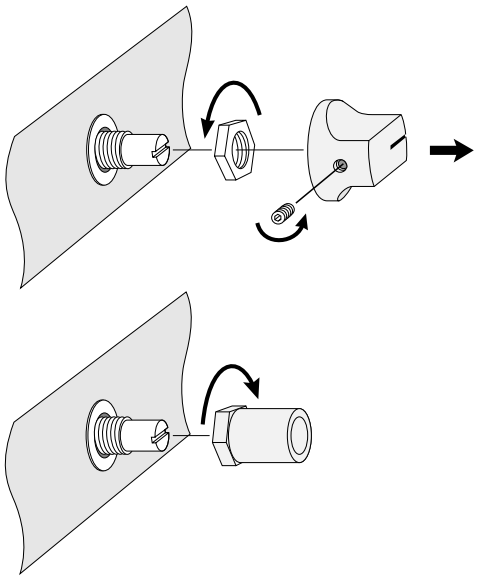


*Fig. 8.4 Installing a Level Control Shaft Lock*

# 9 Service

This unit has very sophisticated circuitry which should only be serviced by a fully trained technician. This is one reason why each unit bears the following label:

**CAUTION: To prevent electric shock, do not remove covers. No user serviceable parts inside. Refer servicing to a qualified technician.**

## 9.1 Worldwide Service

Service may be obtained from an authorized service center. (Contact your local Crown/Amcron representative or our office for a list of authorized service centers.) To obtain service, simply present the bill of sale as proof of purchase along with the defective unit to an authorized service center. They will handle the necessary paperwork and repair.

Remember to transport your unit in the original factory pack.

## 9.2 North American Service

Service may be obtained in one of two ways: from an authorized service center or from the factory. You may choose either. It is important that you have your copy of the bill of sale as your proof of purchase.

### 9.2.1 Service at a North American Service Center

This method usually saves the most time and effort. Simply present your bill of sale along with the defective unit to an authorized service center to obtain service. They will handle the necessary paperwork and repair. Remember to transport the unit in the original factory pack. A list of authorized service centers in your area can be obtained from our Technical Support Group.

### 9.2.2 Factory Service

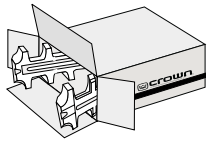
To obtain factory service, fill out the **service information page** found in the back of this manual and send it along with your proof of purchase and the defective unit to the Crown factory.

For warranty service, we will pay for ground shipping both ways in the United States. Contact Crown Factory Service or Technical Support to obtain prepaid shipping labels prior to sending the unit. Or, if you prefer, you may prepay the cost of shipping, and Crown will reimburse you. Send copies of the shipping receipts to Crown to receive reimbursement.

Your repaired unit will be returned via UPS ground. Please contact us if other arrangements are required.

**Factory Service Shipping Instructions:**

1. When sending a Crown product to the factory for service, be sure to fill out the service information form that follows and enclose it inside your unit's shipping pack. Do not send the service information form separately.




**Always use the original factory pack to transport the unit.**

2. To ensure the safe transportation of your unit to the factory, ship it in an original factory packing container. If you don't have one, call or write Crown's Parts Department. With the exception of polyurethane or wooden crates, any other packing material will not be sufficient to withstand the stress of shipping. **Do not use loose, small size packing materials.**
3. Do not ship the unit in any kind of cabinet (wood or metal). Ignoring this warning may result in extensive damage to the unit and the cabinet. Accessories are not needed—do not send the instruction manual, cables and other hardware.

If you have any questions, please call or write the Crown Technical Support Group.

**Crown Customer Service**

Technical Support / Factory Service
Plant 2 SW, 1718 W. Mishawaka Rd., Elkhart, Indiana 46517 U.S.A.

*Telephone:* 219-294-8200
800-342-6939 (North America, Puerto Rico, and Virgin Islands only)

*Facsimile:* 219-294-8301 (Technical Support)
219-294-8124 (Factory Service)

*Internet:* http://www.crownaudio.com

# Crown Factory Service Information

Shipping Address: Crown Factory Service, Plant 2 SW, 1718 W. Mishawaka Rd., Elkhart, IN 46517
Phone: 1-800-342-6939 or 1-219-294-8200 Fax: 1-219-294-8124

**Owner's Name:** _____

**Shipping Address:** _____

**Phone Number:** _____ **Fax Number:** _____

**Model:** _____ **Serial Number:** _____ **Purchase Date:** _____

## NATURE OF PROBLEM

*(Be sure to describe the conditions that existed when the problem occurred and what attempts were made to correct it.)*

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**Other equipment in your system:** _____

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**If warranty has expired, payment will be:** ❑ **Cash/Check** ❑ **VISA** ❑ **MasterCard** ❑ **C.O.D.**

**Card Number:** _____ **Exp. Date:** _____ **Signature:** _____

**ENCLOSE THIS PORTION WITH THE UNIT. DO NOT MAIL SEPARATELY.**

Detach and send with unit.